Popular Science Monthly

INDEX

Volume 92—January-June, 1918

MILITARY AND NAVAL SCIENCE

RADIO COMMUNICATION

RAILWAYS

For the Boys Over There

The War and Navy Departments have asked the American Library Association to provide reading matter for the soldiers and sailors. The POPULAR SCIENCE MONTHLY is one of the two most popular magazines at Camp Upton; the other is a fiction magazine. When the soldiers in camp send in their requests for magazines, they ask not only for fiction, as may be supposed, but also for the POPULAR SCIENCE MONTHLY.

This state of facts leads us to ask readers to place their copies of the POPULAR SCIENCE MONTHLY, after they have been read, at the disposal of our soldiers and also to send along other reading matter of a practical character.

The aviation camps want books on gas engines, on airplanes, on physics and on other pertinent mechanical subjects generally. The Signal Corps want books on telegraphy and electricity. All the separate trades in the Army and Navy want volumes and periodicals that will help the men to do their work better—books about our Allies, the places where our soldiers will be sent, why we are in the war, how the war is fought. Thousands of books will be required and not nearly enough have been given to meet the demand.

Send up-to-date books—books of real present value, not antiquated volumes. Many of the men are studying French and want grammars, readers and dictionaries.

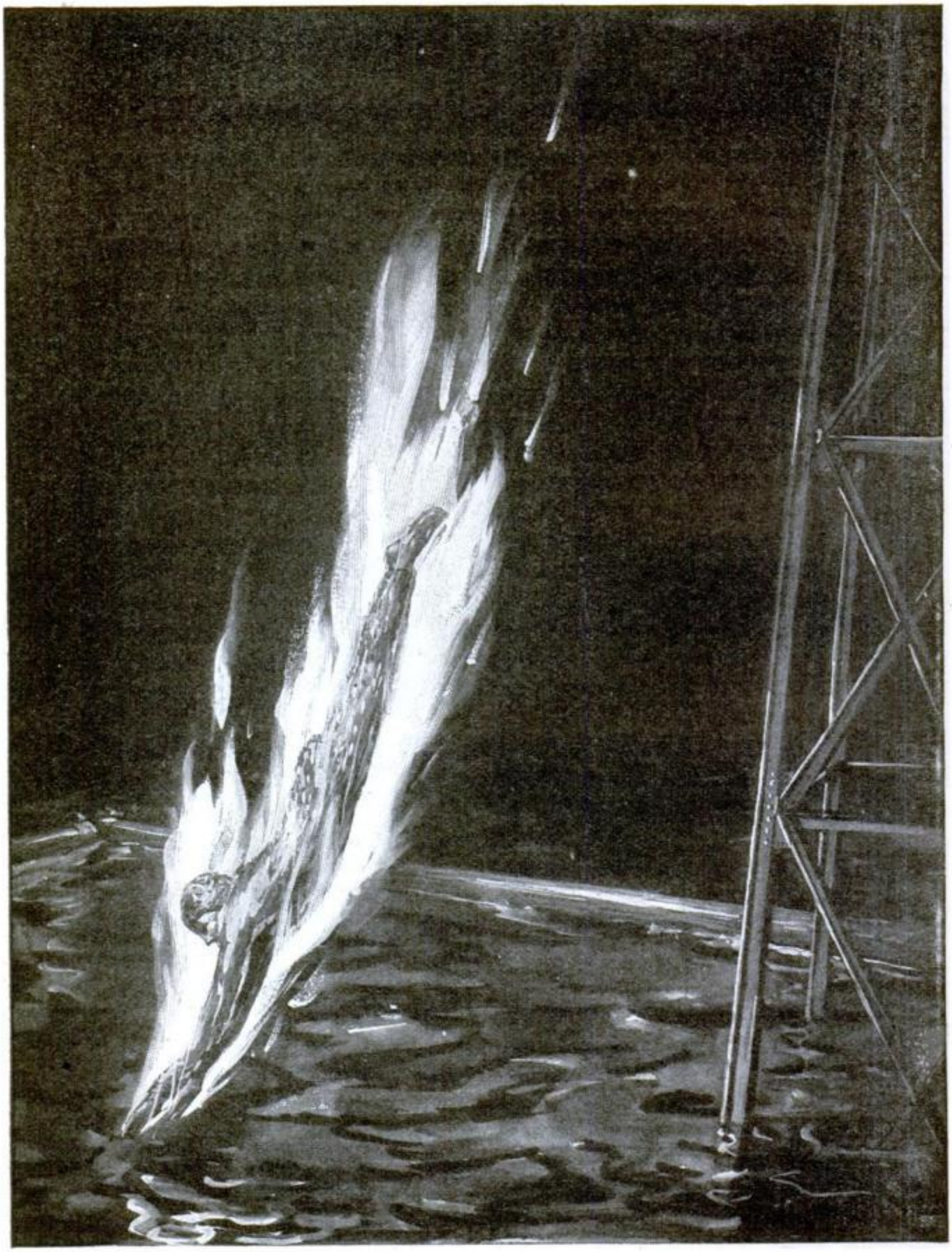
Send the books to the nearest public library. There, they will be sorted and shipped to the soldiers and sailors. The American Library Association will see to it that the books are placed at the disposal of the men. In the larger camps, trained librarians are in actual charge of the library system.

The POPULAR SCIENCE MONTHLY and similar practical magazines may be sent through the Post Office by placing a one-cent stamp on the cover. Or they may be left at the library with the books. Periodicals should not be over two months old.

In case of doubt, take everything to the library. The undesirable material can be sold and the proceeds used to buy suitable books.

Money contributions may be sent to the local libraries or directly to Mr. Herbert Putnam, the General Director of the American Library Association, Library War Service, Library of Congress, Washington, D. C.

The Human Torch Makes His Spectacular Dive



Like a flaming comet, the diver, Jake Cox, plunges fifty feet from a tower into a pool of gasoline. The instant his blazing body touches the surface of the lake, the inflammable liquid is ignited, so that he seems to have plunged into a roaring volcano. He has actually done so—for the fraction of a second—but before the spell-bound spectators can collect their thoughts, he has already reappeared on the surface, forty feet away from the burning liquid

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The Human Torch

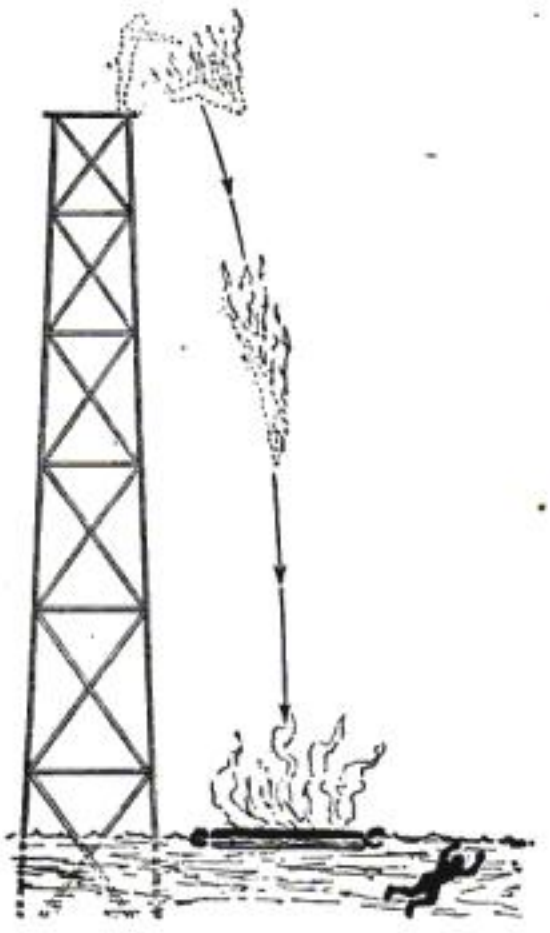
Enveloped in flames, a bold man dives from a fifty-foot tower into a lake of gasoline, transforming it into a seething furnace

IT is night time. On the top of a tower, fifty feet high, stands a queer looking figure, dressed in three suits. The outside one is of cloth, the one under it, is of rubber, and the one next to the skin is of asbestos. On his head are three rubber caps, over which is an asbestos cap that comes down to his shoulders and leaves two holes through which he can see. His gloves, his wristlets, his shoes—all are of asbestos. Directly below him is a square area of water, fenced in with logs or boards. The surface of this boxed-off section is covered with gasoline.

Suddenly an assistant steps up to the figure and lifts a bottle, from which he pours gasoline over the man's body. Around the lake stand two thousand people, fascinated by the actions of two. In a moment, the assistant steps back from the oil-covered figure and shouts a signal to somebody below. Immediately all lights are extinguished, leaving the figure in darkness. Then the stillness is broken by the report of a revolver shot. The assistant has fired at the diver, the sparks from the revolver transforming him into a livid cone of flame. With a shout, he leaps from the platform and in a beautiful parabolic dive, plunges into the lake below. As he flies through the air, his body takes on the appearance of a torch, long tongues of flame trailing out behind him. Striking the film of gasoline, he is enveloped in a veritable inferno of fire, which erupts as soon as his fingertips touch it.

But his work is only half done. If he comes up in the lake of fire he will be burned alive. How does he escape? He swims under water some thirty or forty feet until he has passed the burning gasoline, when he rises to the surface, safely out of danger's reach. This is no easy thing to do, for his shoes and the three heavy suits greatly hinder his movements. Furthermore, he dare not open his mouth or breathe through his nose while he is taking his spectacular dive, lest the flames suffocate him.

It requires reckless courage to be a "thriller de luxe." If the slightest accident or miscalculation occurred, the "Human Torch" would be extinguished for the last time.



How the diver escaped without being burned to death is shown above. At right, above, is Jake Cox, the daredevil, dressed for the feat

How to fold the device over the edge of the glass so that even an ordinary tumbler becomes your special drinking glass

If You Value Your Life, Be Careful with Electricity

SOME safety hints for the wise, which are intended to guard against serious accidents and a possible loss of life, are being sent out broadcast by the electric light companies. From them may be selected the following: Do not cover an electric globe with paper or cloth. It may start a fire. Do not hang an ordinary lamp cord over a nail or metal work. Do not leave a cord connected when you are through with it. Do not touch any wire that is down on the ground, whether it is an electric, telephone or guy wire. In an emergency, remove a wire with an instrument equipped with a wooden handle, keeping the full length of the handle between yourself and the wire.

Make Every Glass a Sanitary Drinking Cup

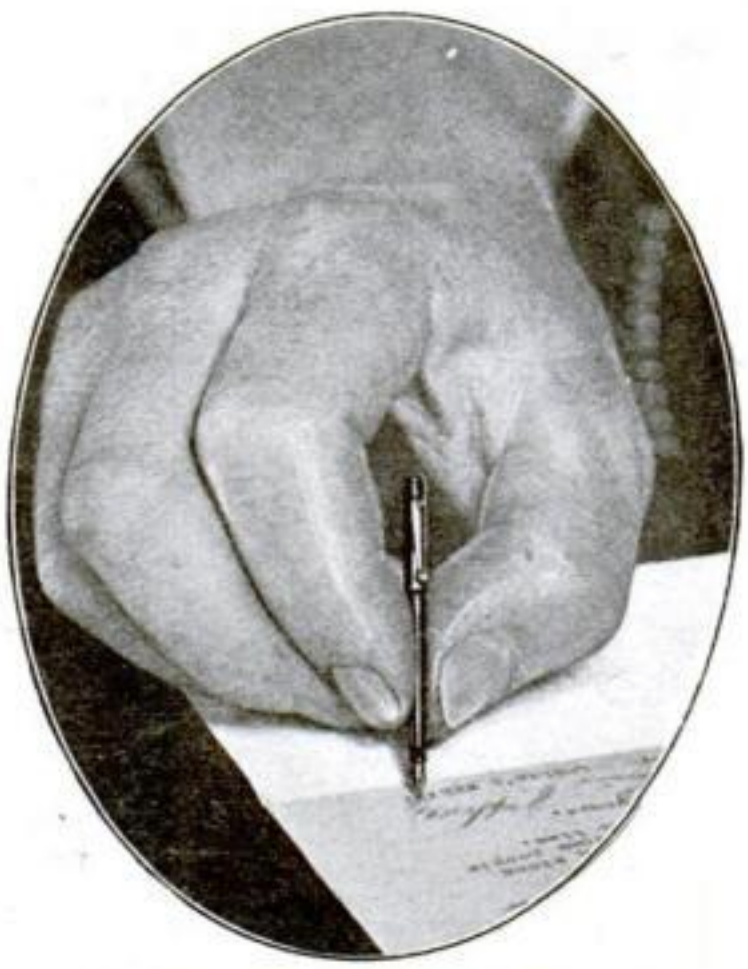
THE simplest of all the recent devices for guarding against the germs, which often lurk even in drinking water, is a small piece of waxed paper, or a semicircular celluloid strip, which folds over the rim of the glass and prevents the lips from touching the surface of the tumbler while drinking.

It will fit over any glass or cup, and will make it possible for you to enjoy an ice-cream soda, or a drink of water anywhere. The part of the paper which is held inside the glass will prevent any sediment, which may be in the bottom of the glass, from reaching your lips. This little invention, is the idea of a woman, Miss Cornelia Fiske, of Baltimore, Md.

The Smallest Fountain Pen in the World. It is Two Inches Long

THE fountain pen shown in the accompanying illustration might well be used to exemplify the slogan "Perfection in little things." It was made as a tiny sample, by a prominent fountain pen manufacturing company, and is as perfect in every respect as the pens of usual size. It holds only a few drops of ink, but while the ink lasts, the pen can be used to very good effect.

It is provided with a pocket clip that is perfectly able to perform its duty, regardless of its diminutive size. It is carried in a box with its own little filler, and the printed directions for its use just exactly as if it were being offered for sale like its big brothers.



A tiny pen which writes as perfectly as its big brothers

Seeing the Stars from the Bottom of a Well

THAT stars are visible in the daytime from the bottom of a deep shaft or well has been generally believed since the days of Aristotle, but there is not the slightest foundation for the idea. Baron Humboldt, who spent a good deal of time in mines himself and questioned miners in various parts of the world, found no evidence in support of this belief, and it has since been thoroughly exploded. But like many other "exploded" ideas it flourishes just as vigorously as ever.

Fireproof Leggings for the Foundry Worker

THE foundry is the one workshop where old shoes, such as the workman loves to don for the sake of comfort, are not worn —or should not be. They offer too little protection against splashes of the molten metal. Usually a Congress shoe of specially prepared leather is worn, over which a legging is fitted to protect the leg and knee.

A very good type of legging for the foundry is shown in the accompanying illustration. It is made of asbestos in the shape of a boot and covers not only the leg and knee but the top part of the foot as well. It is held in place by steel bands which fasten round the leg with spring clasps. Structural steel workers riveting white-hot bolts into big beams need not worry about exposed legs when they are so well protected with asbestos leggings. Men who use the oxy-acetylene flame in confined spaces would find the leggings convenient.

Asbestos leggings protect every part of the foot, including leg and knee

Photos © Western Newspaper Union

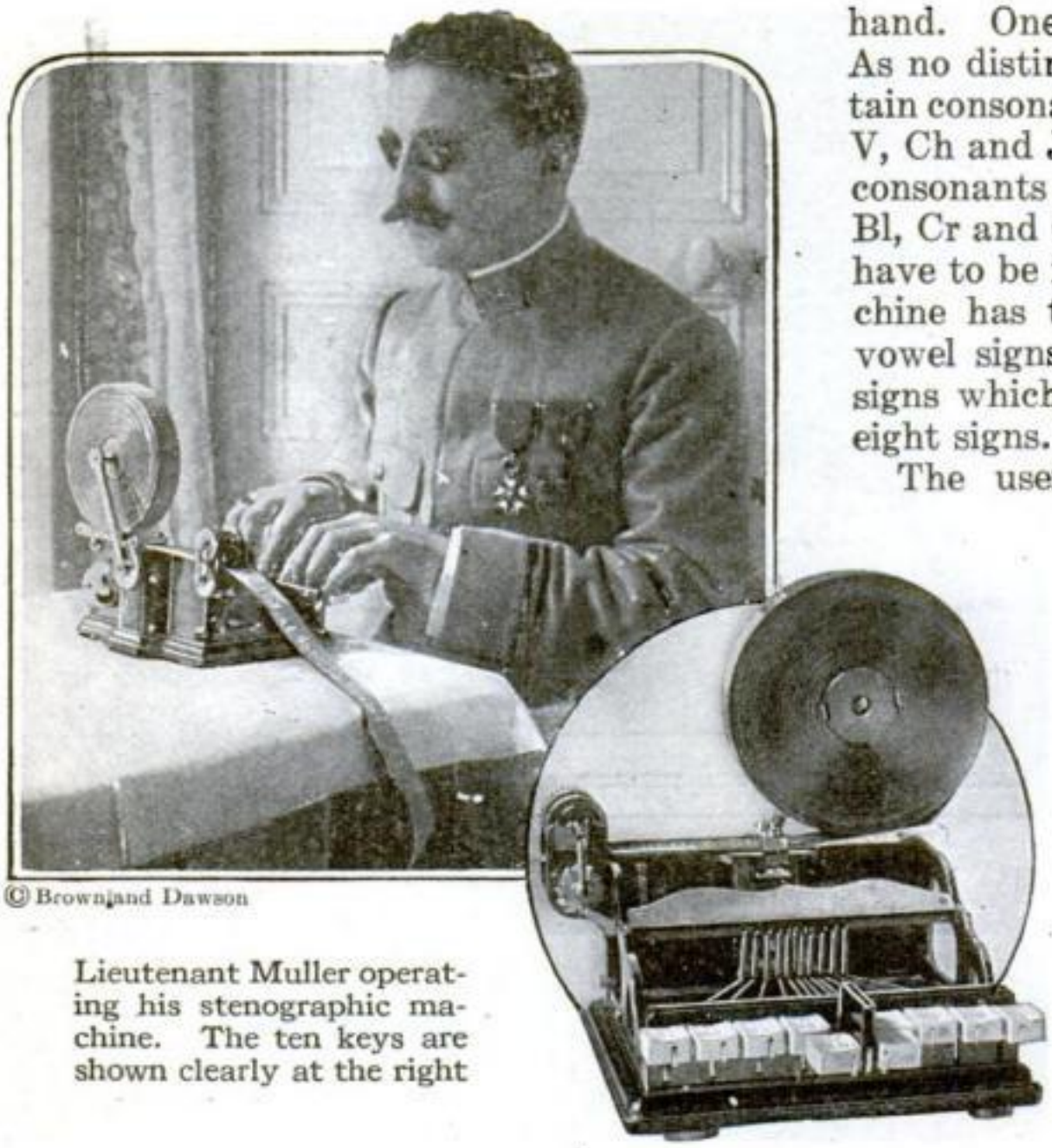
How the German mask protects the sniper as he lies prone on the ground

The cut-out on the side of the mask is to enable the wearer to use a rifle

The Latest Thing in German Sniper's Masks

A HEAVY metal mask captured from the Germans by the Canadians on the western front attracted considerable interest in army circles. It is made of one quarter-inch Krupp steel and although it is not much larger than a man's head it furnishes ample protection for a sniper lying prone upon the ground.

The cut out on the right of the mask permits a rifle to be held to the shoulder in the natural position. Note the peculiar sloping eye slits. Evidently they were cut this shape to conform to the angle of the eye as the sniper turns his head to peer through either of the slits, which are so far apart that only one at a time can be used. It has been suggested that a whole army of fighters should be equipped with masks of a similar nature, to reduce the very great number of head wounds. This is obviously impracticable.



© Brown and Dawson

Lieutenant Muller operating his stenographic machine. The ten keys are shown clearly at the right hand. One motion writes a syllable. As no distinction is made between certain consonants, such as T and D, F and V, Ch and J and other combinations of consonants such as Br and Pr, Pl and Bl, Cr and Gr, each consonant does not have to be indicated. The Muller machine has ten consonant signs, fifteen vowel signs and three final consonant signs which make, altogether, twenty-eight signs.

The usefulness of the machine is greatly enhanced by its size and weight. It is small enough and light enough to be carried in a valise. The paper is fed through the machine from a large roll. The signs are embossed on the strip of paper by the pressure of the keys. When the blind man wants to read his notes all he has to do is to pass the paper tape which has unfolded from the reel, through his fingers.

A Blind French Soldier Invents a Stenographic Machine

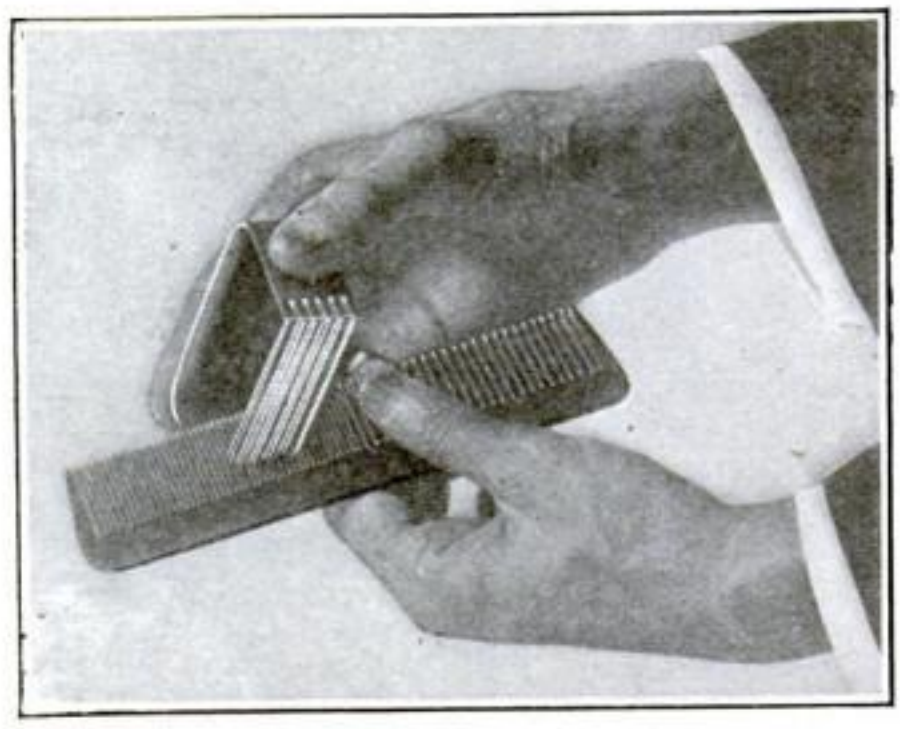
LIEUTENANT MULLER, a Frenchman blinded in the war, has invented a machine for blind stenographers. It promises to simplify the work of teaching stenography to men who have been deprived of their sight, thereby providing them with a means of earning a livelihood.

The machine is constructed for a phonetic system of stenography. The signs are expressed by raised points, each sign representing an entire syllable. The keyboard is divided into two parts, five keys for the right hand and five for the left. Thus the initial consonants of the syllables are written with the left hand and the final consonants with the right

Lengthening the Period of the Comb's Usefulness

KEEPING the comb in a sanitary condition is not so easy a task as it would seem. Merely washing it with soap and water has little effect. A reliable comb-cleaner is needed. The cleaner shown in the accompanying illustration is the invention of A. Abraham, of Rockford, Ill. Its strings are of steel, covered with twisted brass wire, which is just rough enough to scrape the sides of the teeth and the intervening bottom spaces, without making the teeth themselves rough.

The framework is finished in various styles. Some of them are nickeled, some are finished in copper and some in oxydized brass.



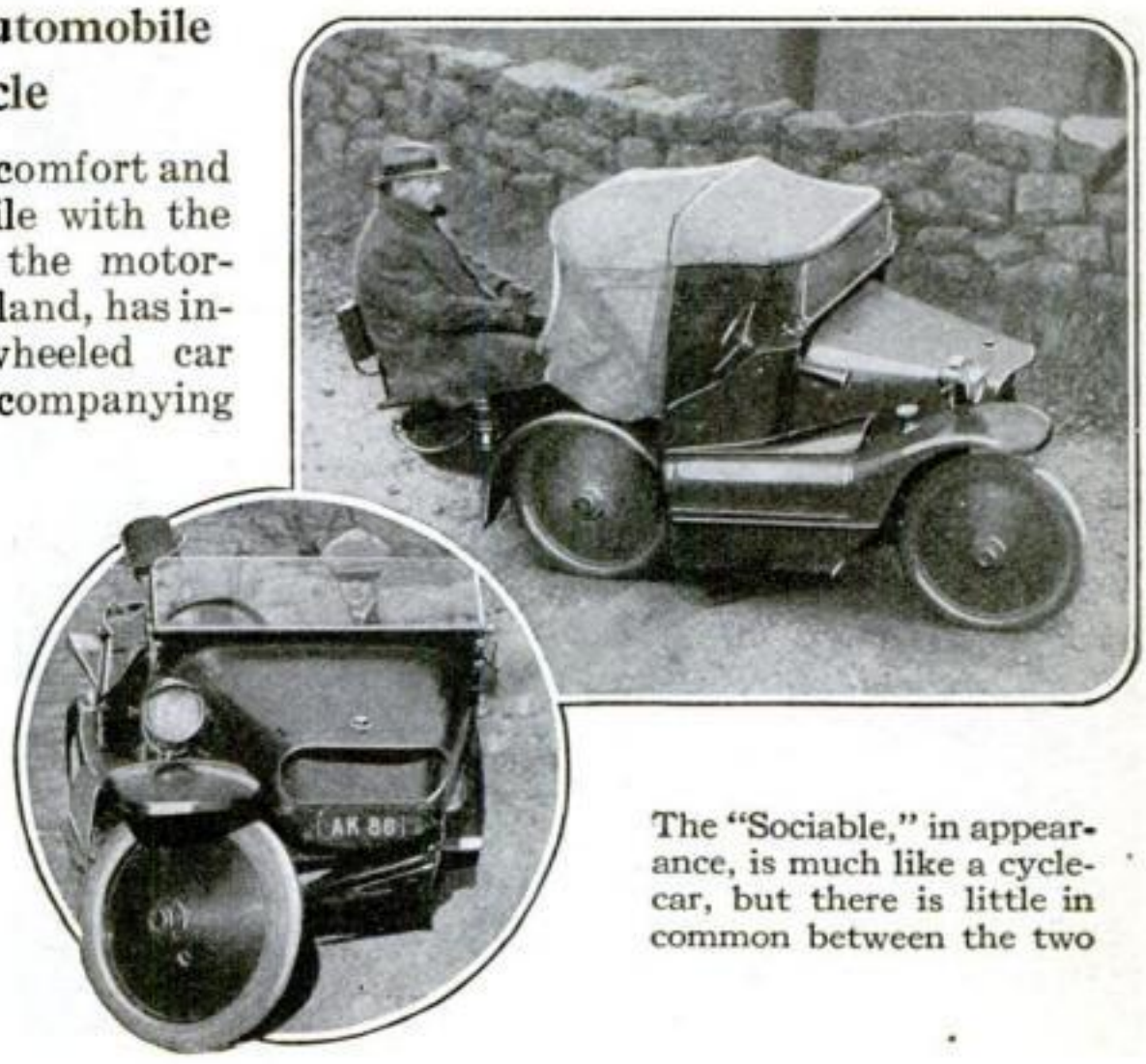
The cleaner will not be out of keeping with the prettiest dressing-table articles

A Hybrid Between the Automobile and the Motorcycle

IN an effort to combine the comfort and stability of the automobile with the economy and lightness of the motorcycle, Alfred A. Scott, of England, has invented the small three-wheeled car which is shown in the accompanying photographs.

The "Scott Sociable," as it is called, looks more like a cyclecar than anything else. Technically speaking, however, there is little in common between the two. The one is nothing more than a high-seated motorcycle with a sidecar attached to it. It is uncomfortable and is liable to skid and tilt on making a sharp curve. The "sociable," however, is designed as a complete unit by itself. It is mounted on a rigid, triangular framework and its seats are carried low inside of the wheel base, so that stability is gained despite its wonderful lightness.

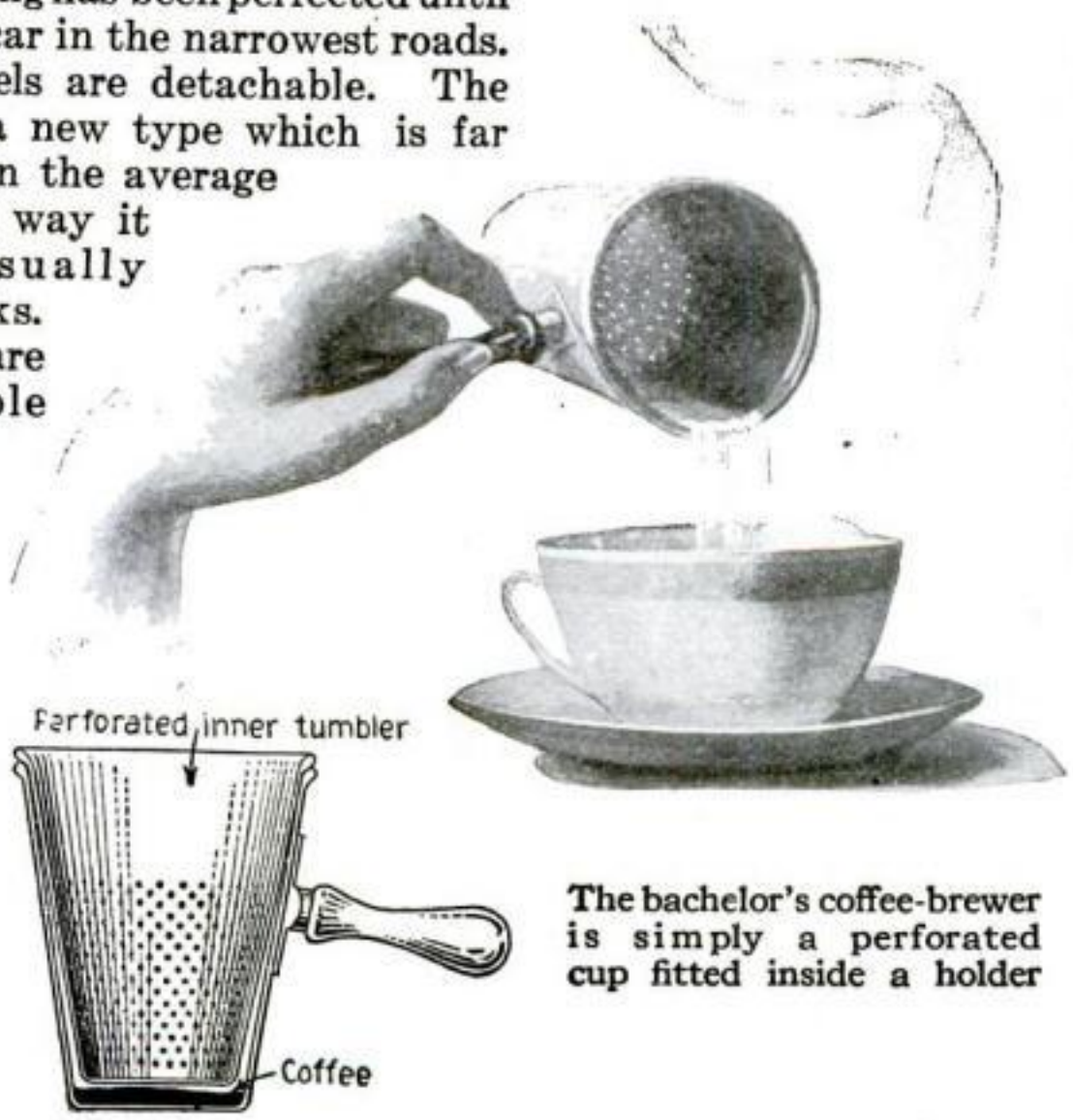
Practically every part has been given special attention. The caster wheel method of steering has been perfected until it can turn the car in the narrowest roads. All of the wheels are detachable. The springs are of a new type which is far ahead of any on the average light car in the way it absorbs unusually violent shocks. These springs are also detachable and can be readily replaced. Inside the car there is every approved type of accessory and appliance. Not the least of these is the hood which can be erected over the driver and his passenger in a storm.



The "Sociable," in appearance, is much like a cyclecar, but there is little in common between the two

The Bachelor's Coffee-Brewer. It Makes One Cup at a Time

NOW comes the coffee-brewer, a device for making individual cups of coffee. The device consists only of two cups somewhat conical in shape, one of which fits into the other. Sufficient pulverized coffee is placed in the bottom of the outer cup to make one cup of the beverage. Then the perforated inner cup is set in place and boiling water is poured into it. It is left to "draw" for a few minutes, just as in the preparation of tea; then it is poured out into the waiting cup. The perforations in the inner cup of the device, strain the beverage.



The bachelor's coffee-brewer is simply a perforated cup fitted inside a holder

The Powder That Sends a Sixteen-Inch Shell

Twenty sacks that will later contain the powder charges for sixteen-inch shells are cut in one operation with an electric cutter

Sewing the sacks together is as important as it is tedious. When finished, each sack must undergo a rigid examination

Canvas sacks are used to contain the igniters that are placed at the bottom of powder sacks. The sewing is done by women who are fast workers with the needle

Women also fill the igniters that explode the charge behind the shell. The powder is tamped down solid by the sticks which they hold. This work is not as dangerous as it looks.

On Its Way Is Packed in Canvas Sacks

© Photo by Kadel and Herbert

Before the powder containers are sent to the various battleships they are tested with compressed air to prove their strength

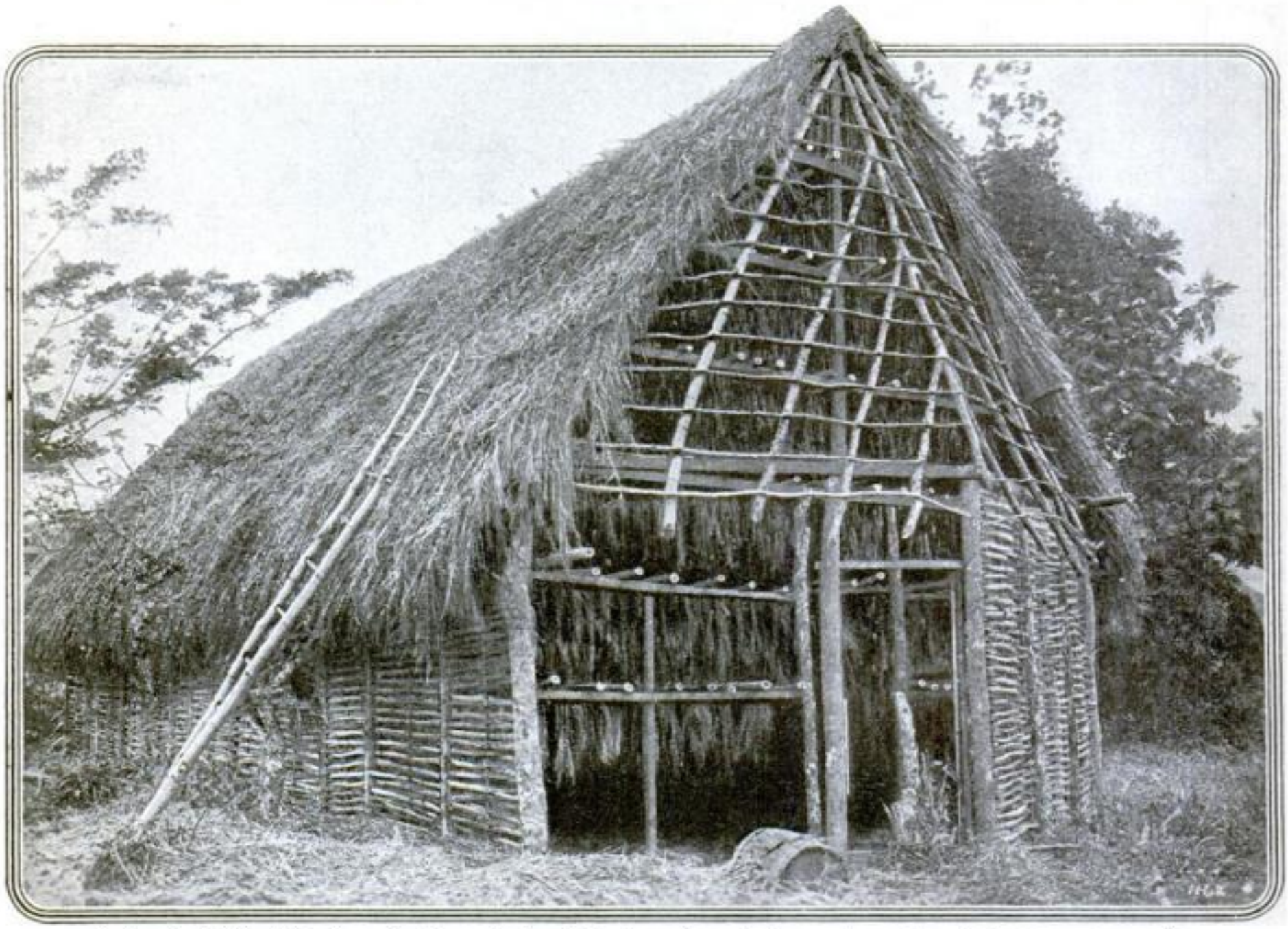
Weighing the powder is absolutely necessary, for each charge must contain precisely the same amount

At right: Filling the bags with powder. Each bag contains sufficient powder to hurl a sixteen-inch shell through space at the rate of over 2000 feet a second

Lacing a powder sack is the last operation. It must make a compact bundle to avoid friction

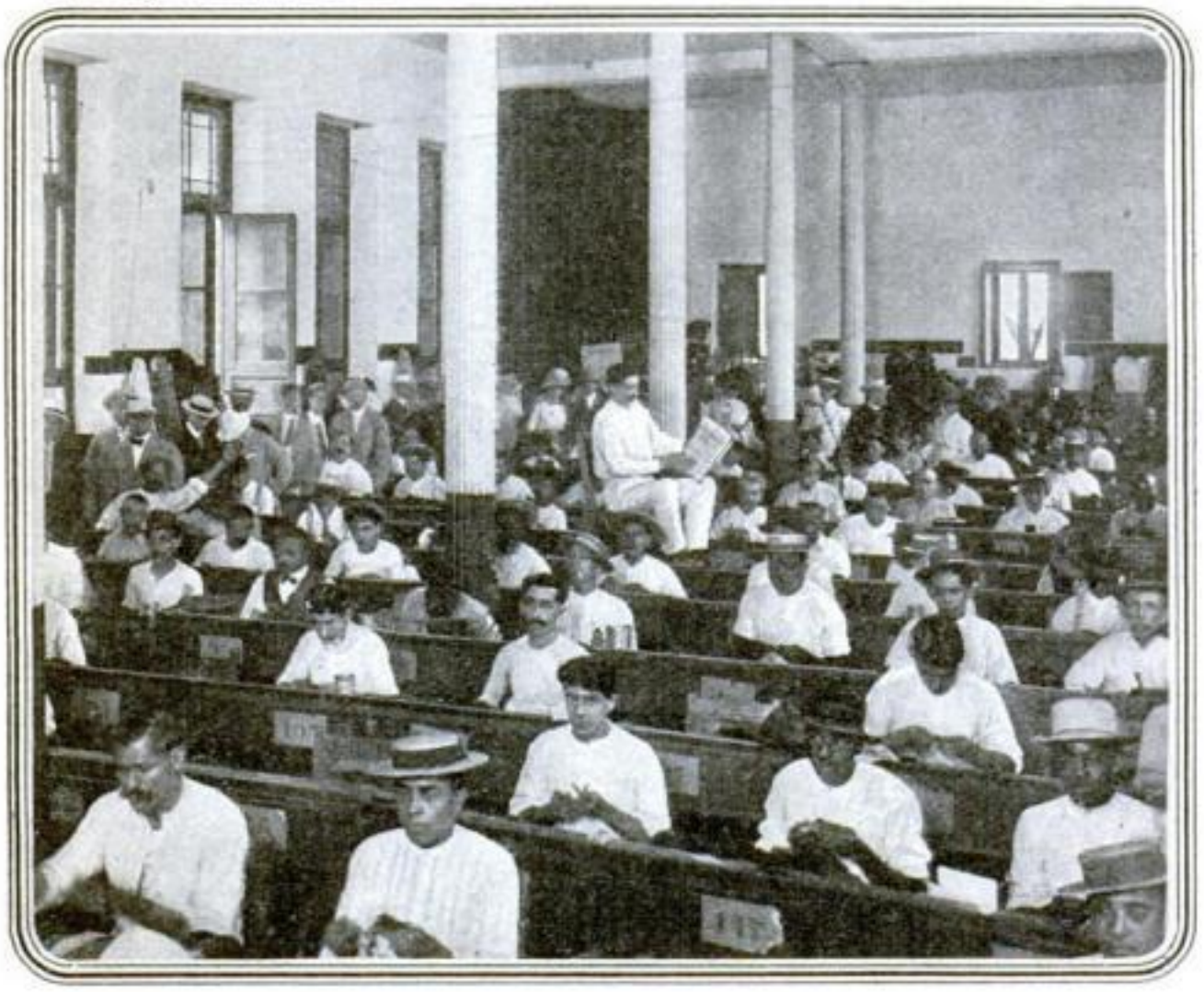
The completed sack—it holds just enough powder to propel one shell

A Leaf of Havana Tobacco Is Heir to More



A typical West Indian drying shed. During the drying stage the tobacco grower is constantly on the anxious seat lest a drought shrivel up the leaves or a heavy rain cause them to sweat and become gummy. The shed has to be constructed so that it may be quickly opened or closed according to the changes in the weather, which is often uncertain

Photos © Brown and Dawson



The very best grade of cigars, the clear Havana, is produced entirely by hand, just as it was two centuries ago. One man can make about one hundred and fifty cigars a day and he is paid by the piece. But no cigar-maker in Havana will work unless a man is employed whose duty it is to read aloud each edition of the daily papers. All the local and general news must be read, as well as the continued stories

Afflictions Than Is the Man Who Smokes It

Collecting tobacco leaves under a covering of cheesecloth. The direct rays of the sun make the leaves small and heavy bodied. To produce large, thin, silky leaves for cigar-wrapper purposes, the plant must be protected by cheesecloth or a latticework of lathing

"Barn cure," or the drying of the green leaves, is the most painstaking task of all. The leaves are strung about an inch apart on poles or strings, which are hung up in barns, tier over tier. Good ventilation is necessary to prevent stem rot and sweating

Patron saints and national ideals enter into the symbolism of these medals, awarded in recognition of distinguished service

"Well Done, Thou Good

JAPAN
ORDER OF THE RISING SUN
SIXTH CLASS

RUSSIA.
ORDER OF ST. GEORGE

ITALY
MILITARY ORDER OF SAVOY
FIFTH CLASS

MONTENEGRO.
ORDER OF DANILO I.
FOURTH CLASS.

ROMANIA
ORDER OF THE STAR
MILITARY
SECOND AND THIRD CLASS

SERBIA
PETER I.
ORDER OF KARAGEORGE

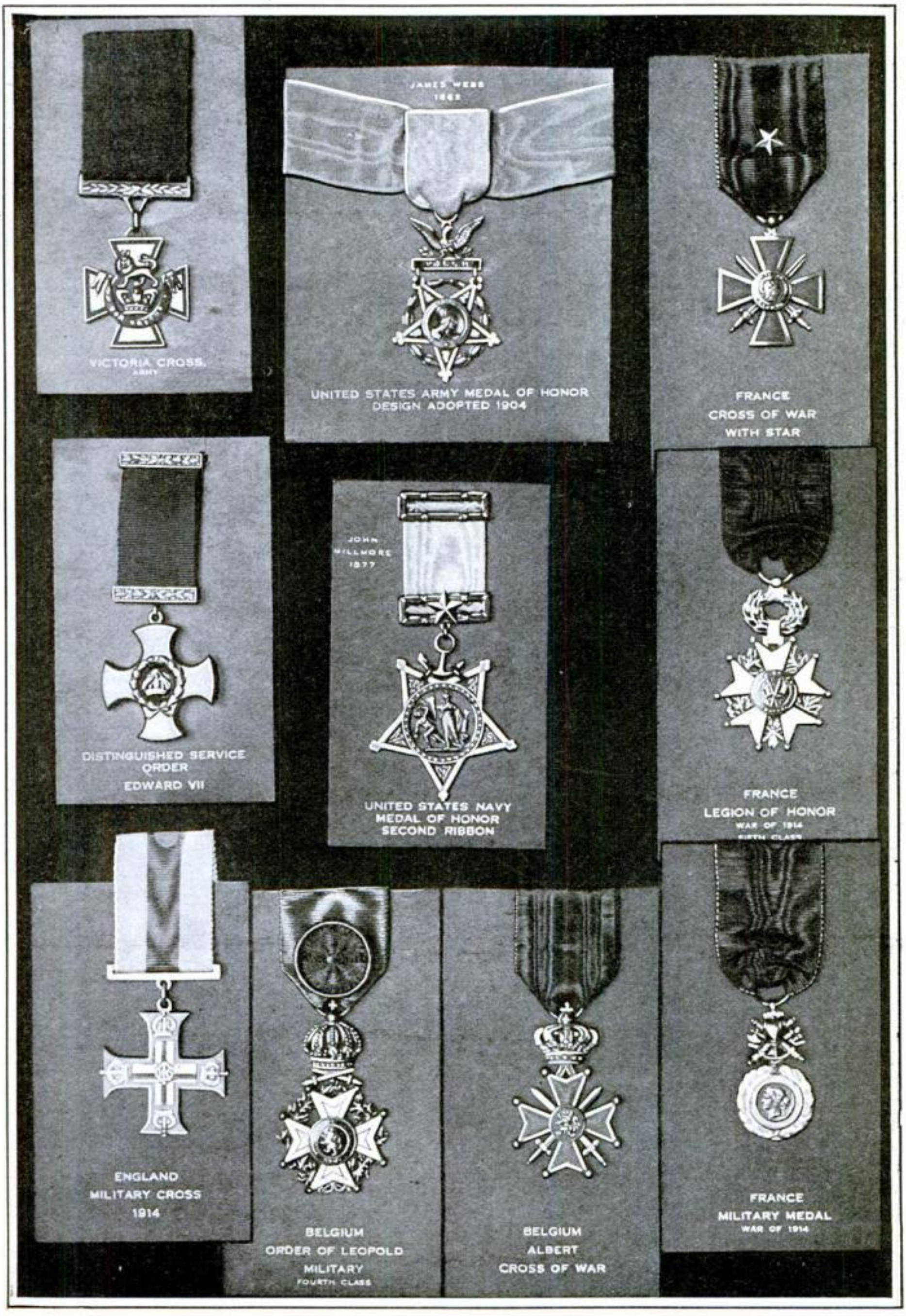
TURKEY.
ORDER OF THE OSMANIE.
FIFTH CLASS

AUSTRIA
ORDER OF THE IRON CROWN.
THIRD CLASS.

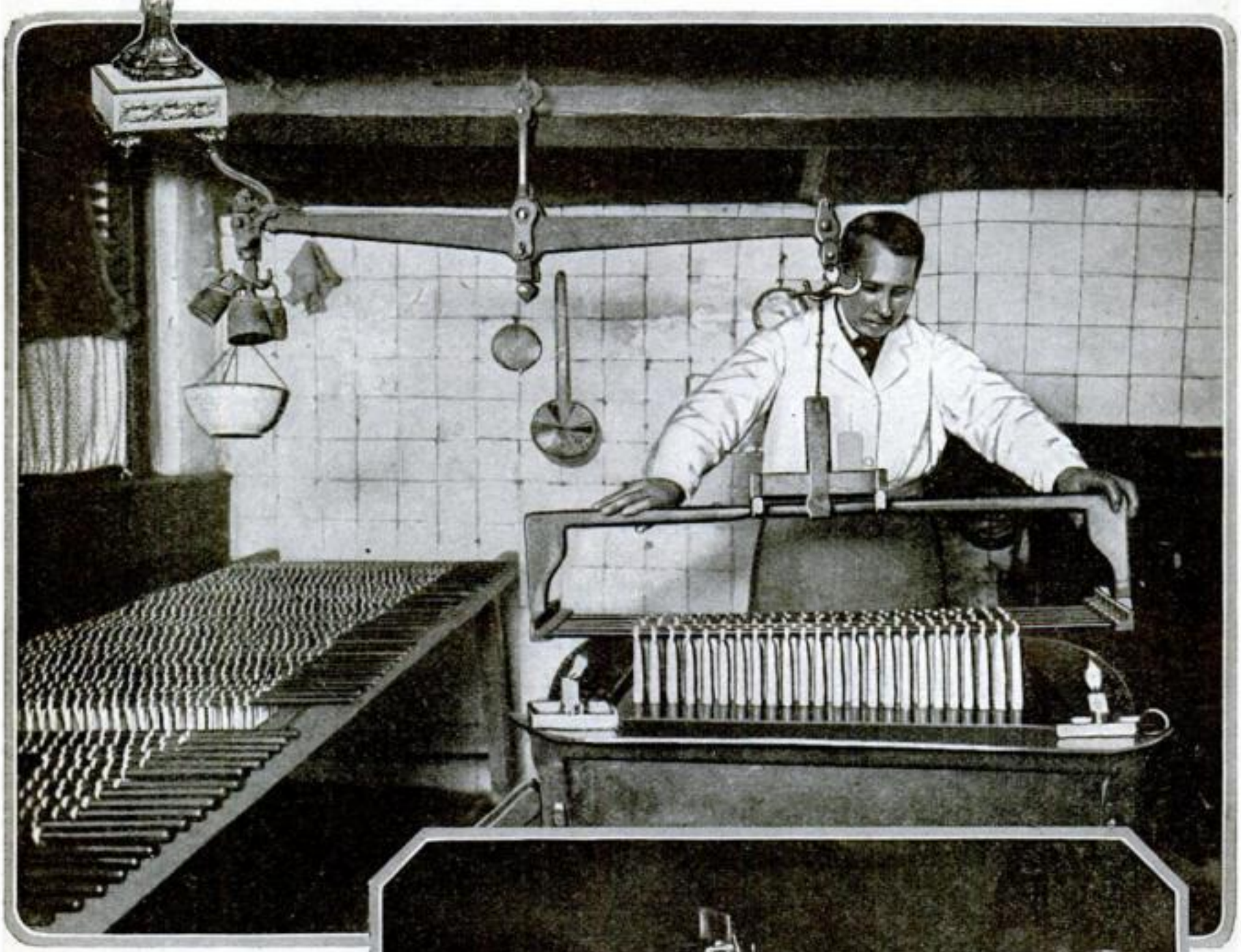
BULGARIA
ORDER OF MERIT.
CIVIL.
SIXTH CLASS.

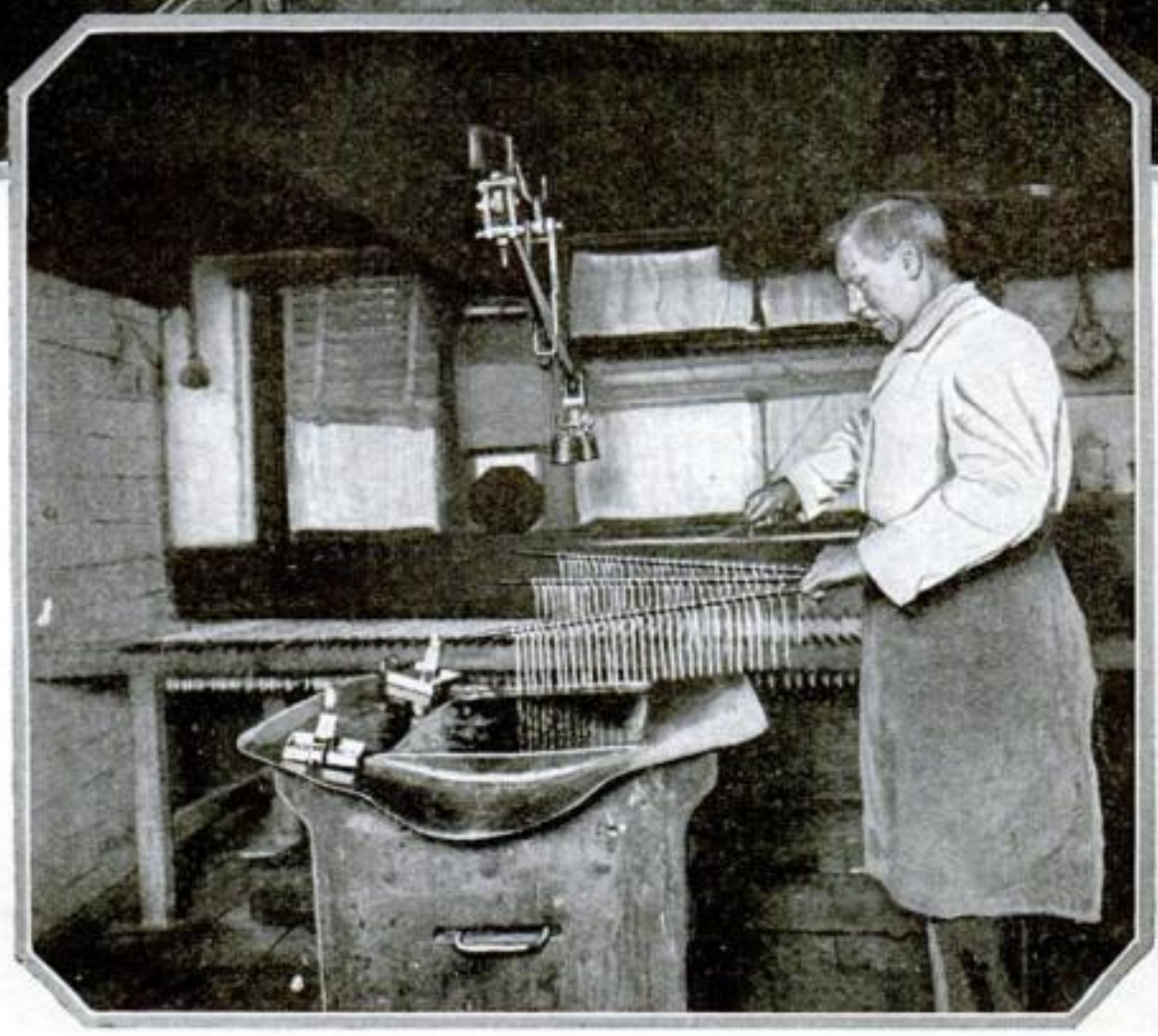
and Faithful Servant"

The American Democracy has only two distinguished service orders. A few famous foreign medals are also shown below



The Largest and Smallest Candle Factories in the World Are Situated in Holland, and They Are Turning Out Their



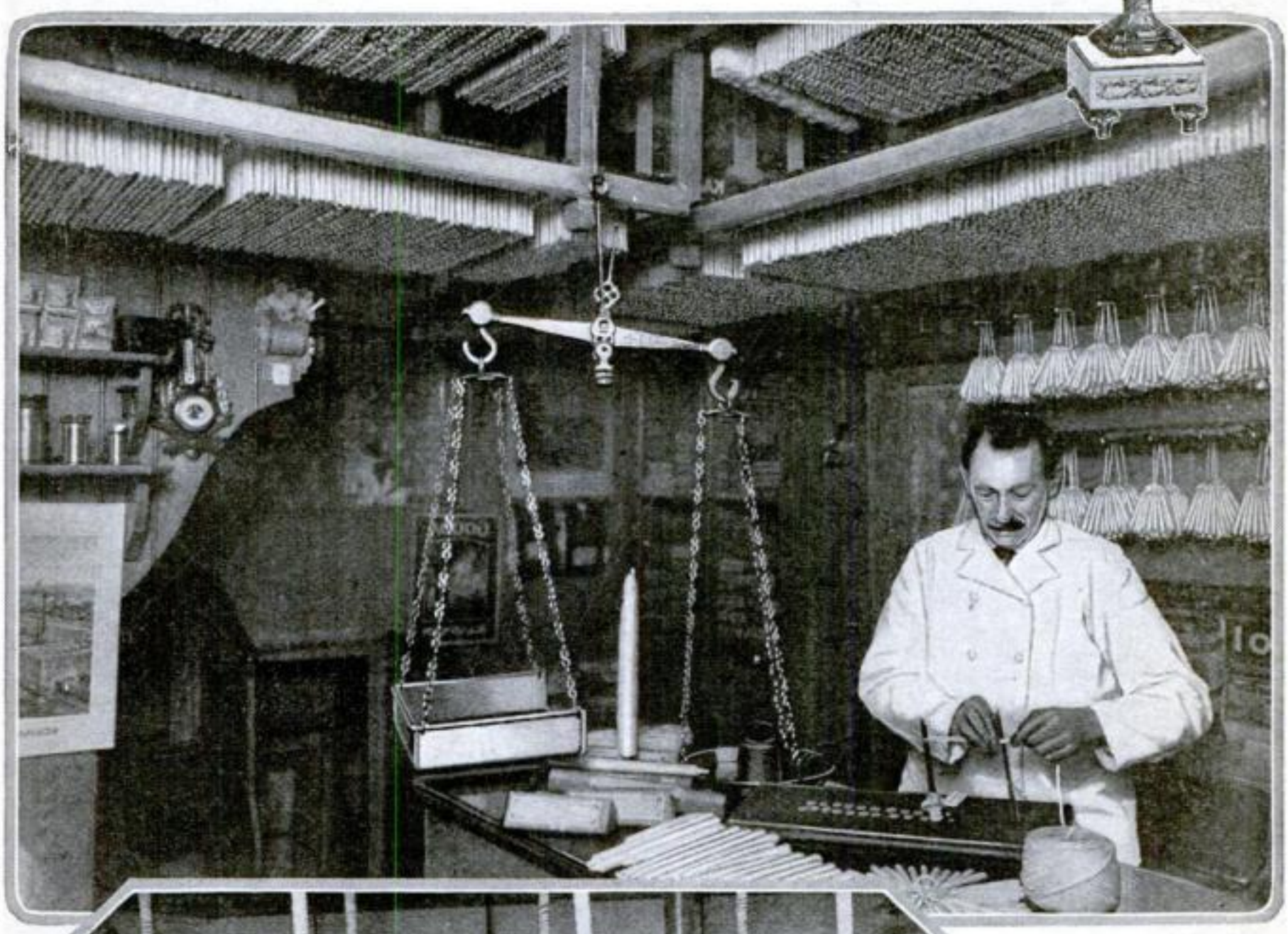


Photos © Brown and Dawson

Above: Suspending the candles in their bath by means of a scale. This enables the workman to withdraw them quickly or dip them just the right length

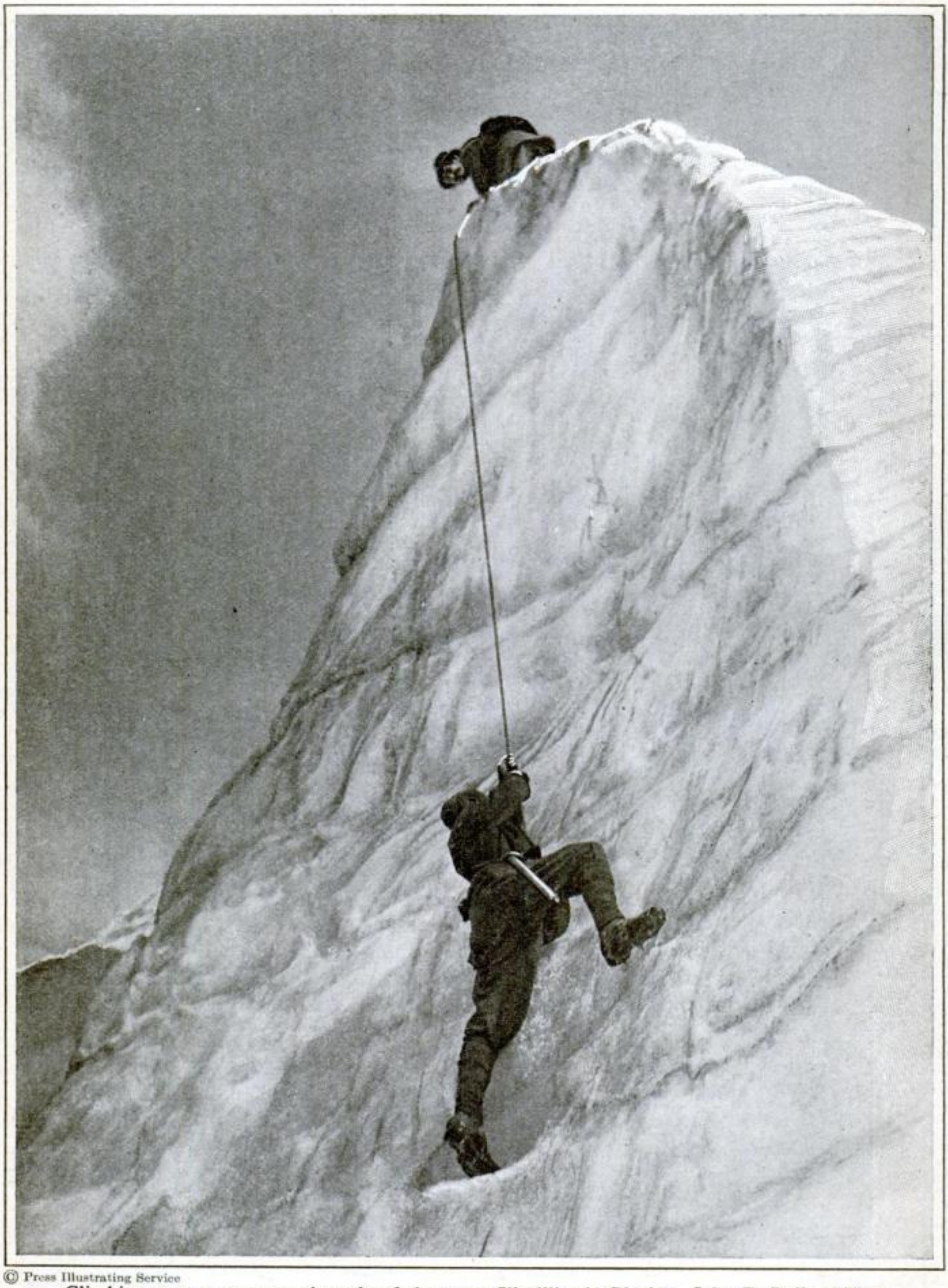
When the wicks have been cut the proper length they are fastened to sticks and then dipped in grease until the right thickness is obtained

Age-Old Product with an Utter Disregard for Electricity or Any of Our Modern Manufacturing Methods



The smallest candle factory in the world is shown above. Candles are stored in crates hung from the roof. The shop is located in Amsterdam, Holland

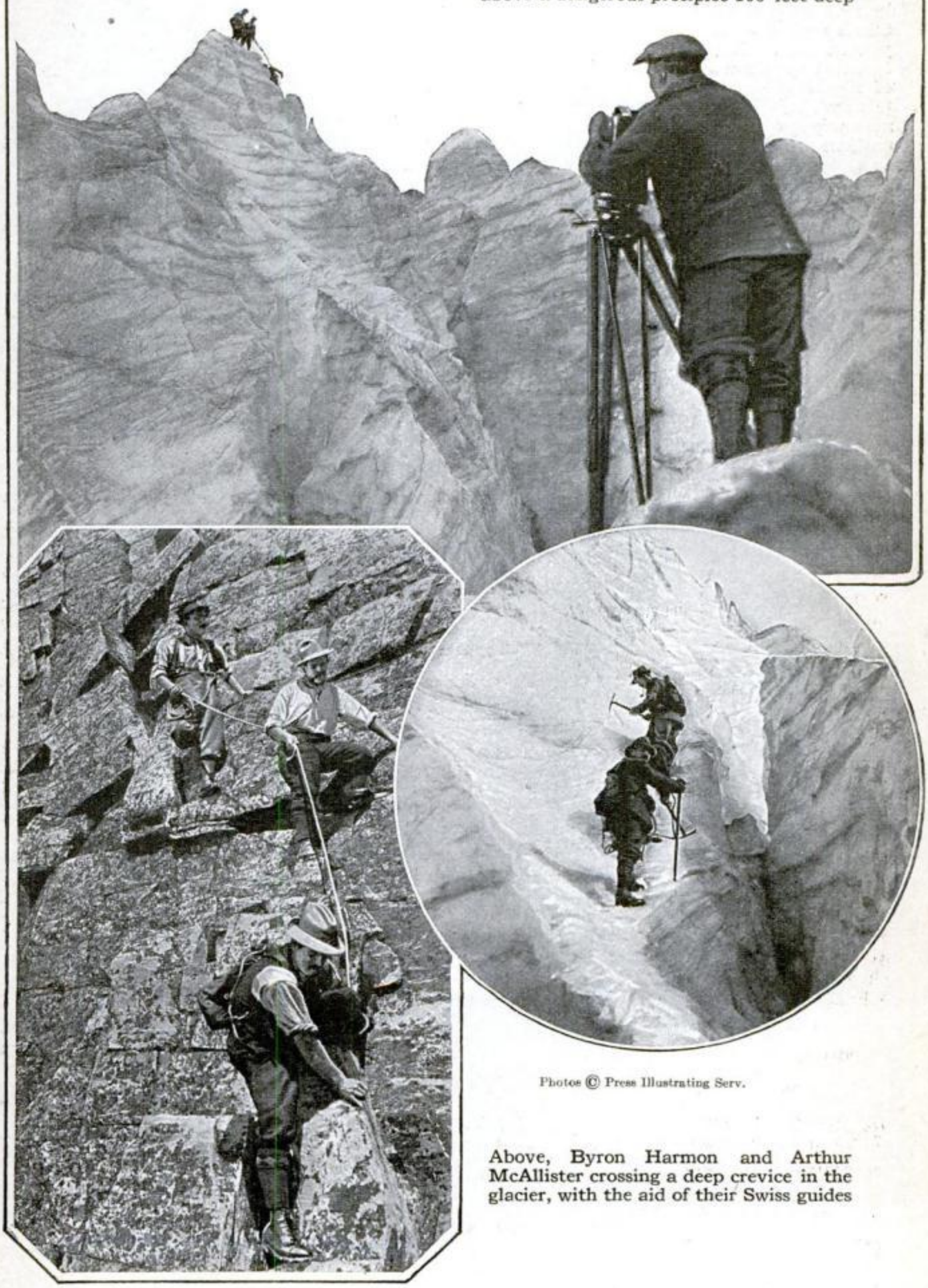
The largest candle factory in the world, at Gonda, Holland. It has an output of hundreds of thousands of candles a day. Note the way they are packed



Climbing over a serac or pinnacle of the great Illecilliwait Glacier. John R. Bell, of New York, is hanging to the rope. He takes desperate chances, not for fame or for the love of the sport, but in order to get a good position for his camera. No one can "double" with him. He has to take the chances involved in hazardous motion picture work

Rockies Pose for the Motion Pictures

The newspaper photographer is seen perched on an overhanging ledge of ice, above a dangerous precipice 100 feet deep



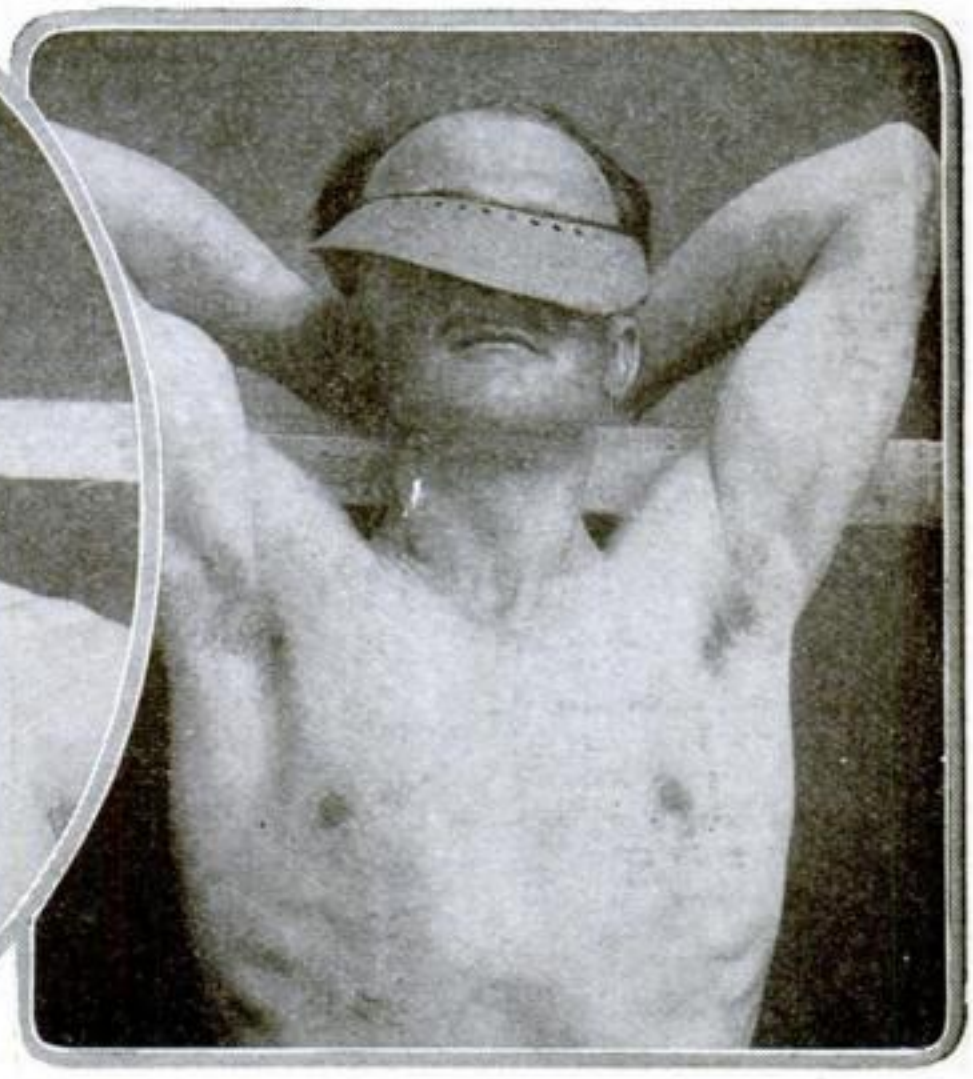
Photos © Press Illustrating Serv.

Above, Byron Harmon and Arthur McAllister crossing a deep crevice in the glacier, with the aid of their Swiss guides

You Don't Have to Be Born Perfect to

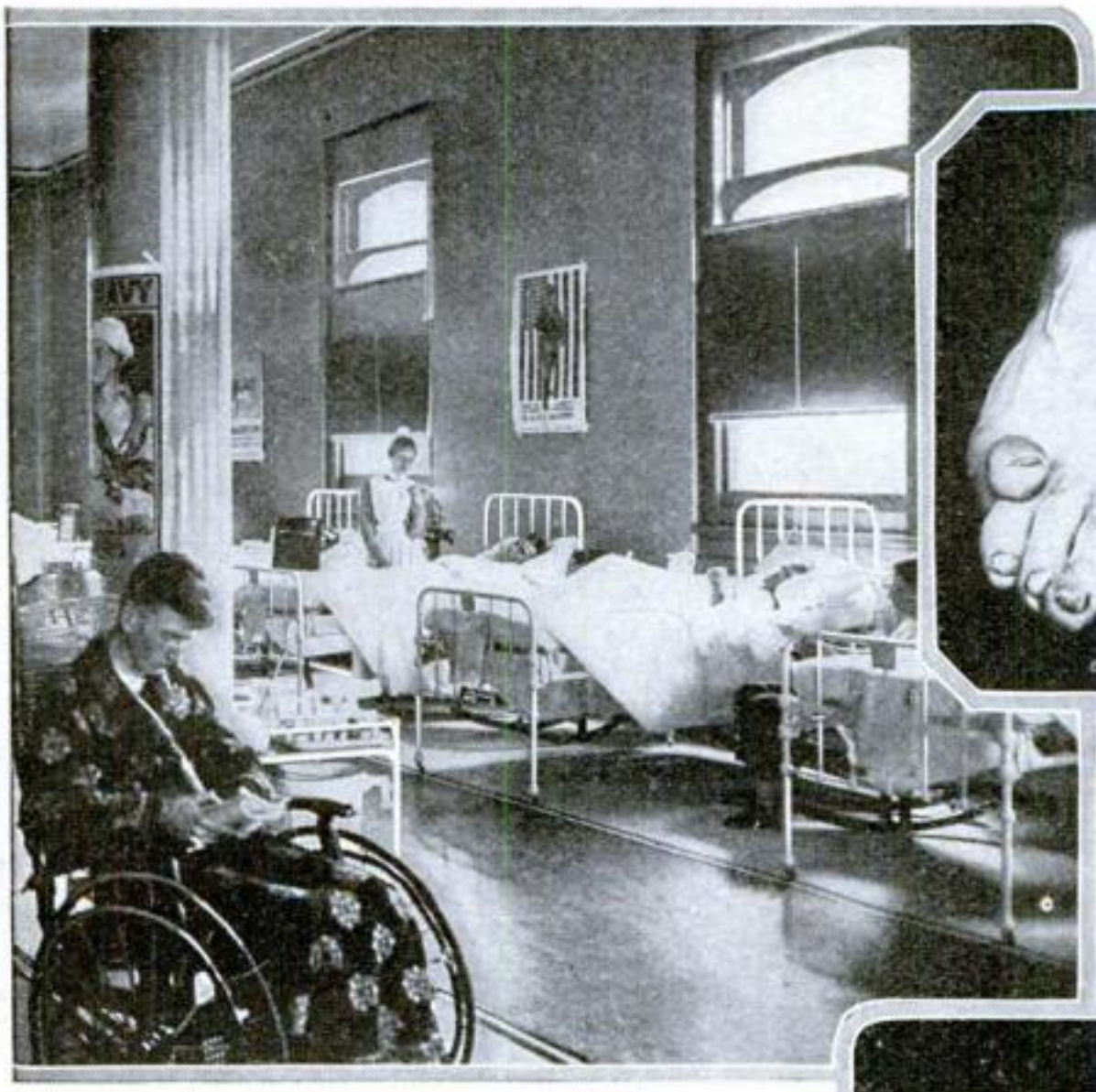
Our country's navy rejected you, Oscar, on the strength of your varicose veins which we show below. Even the United States army did not want you at first. But they operated upon you in one of the New York hospitals and, behold, you are now wearing the service uniform of Uncle Sam

A scene in one of the New York hospitals which has over for their country's service. Young men who are some physical defect are given free treatment in many fellows in uniform and good spirits, too, for they

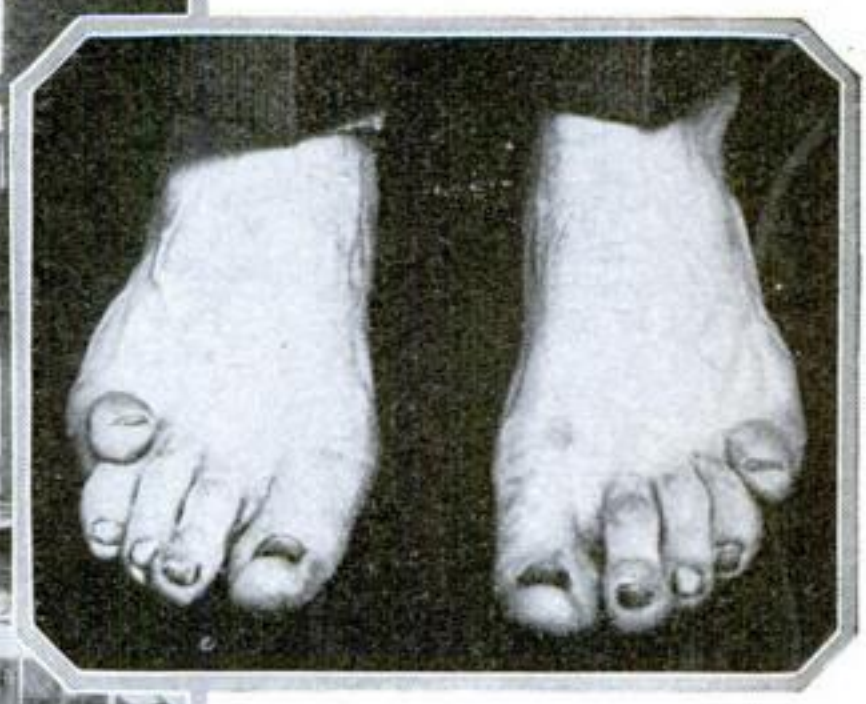


His right collar-bone (it's the left in the picture) was broken, and it was badly bar and perform gymnastics better than most editors we know. And so he is

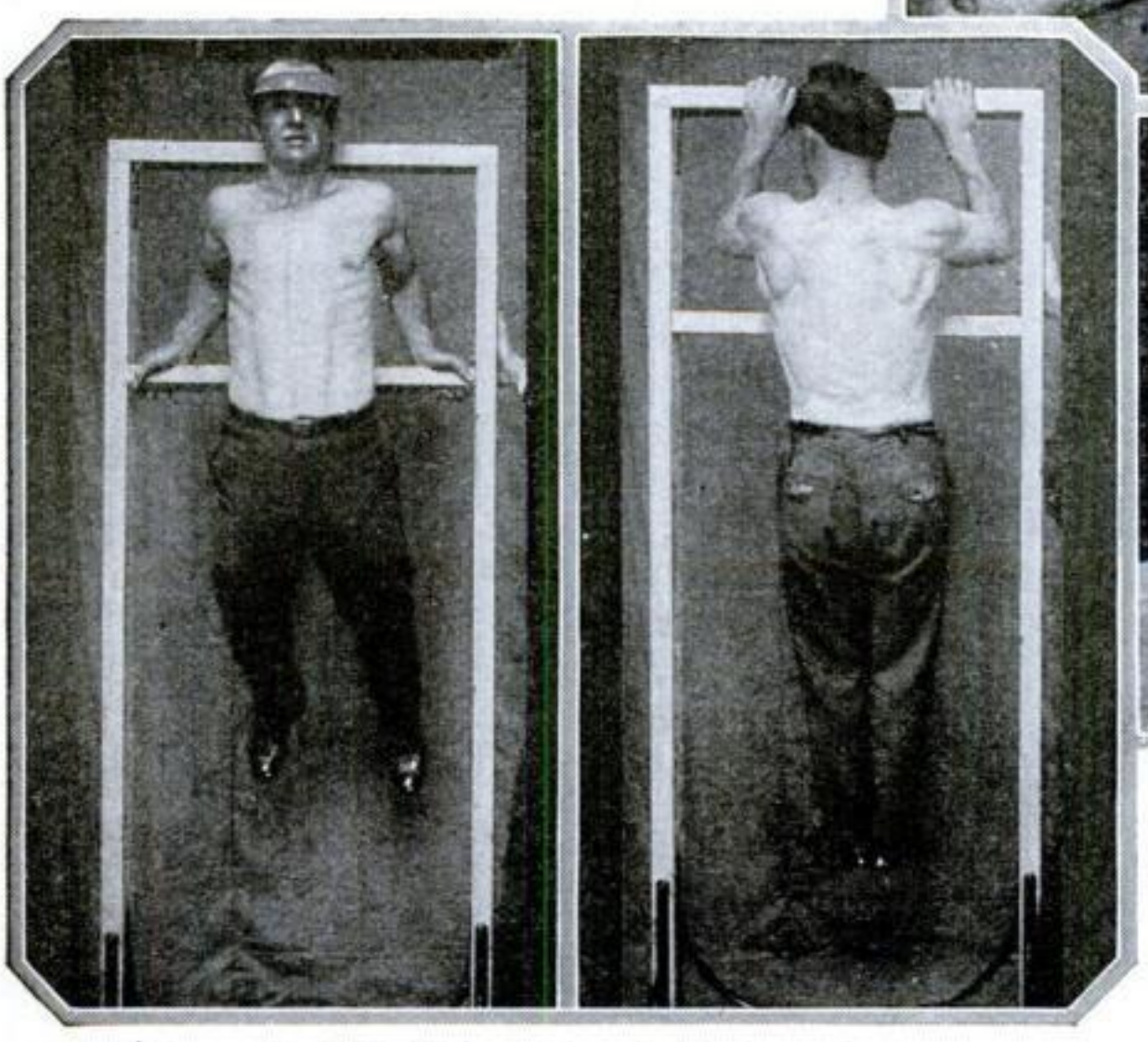
Wear a Uniform—You Can Be Made Over



devoted a ward to the work of making men anxious to serve but are hindered because of hospitals. This work has put a lot of young feel better now than they ever did before



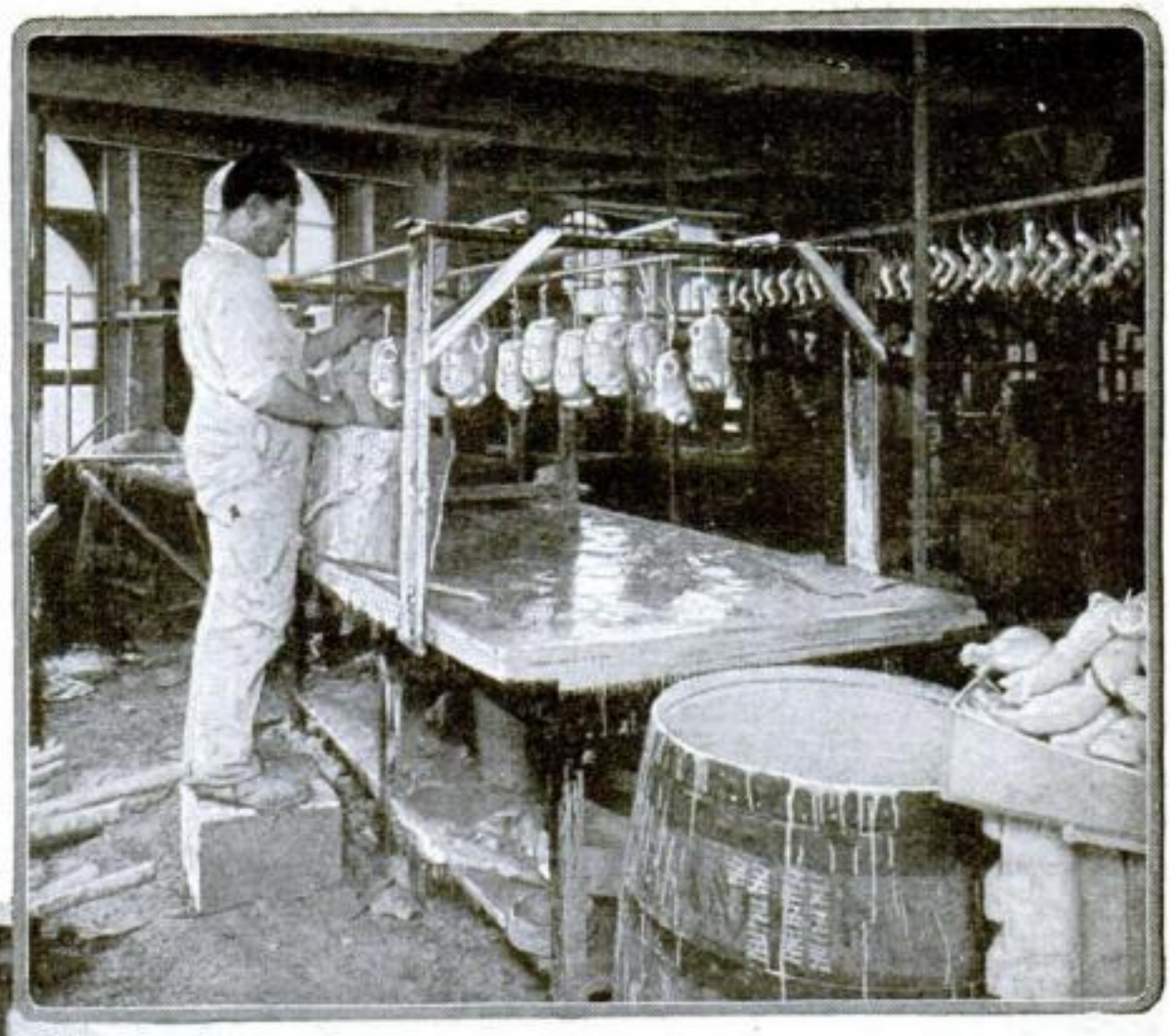
Not a marching foot—but the owner of the overlapping toes will shoulder a rifle. His feet are normal now. One of New York's hospitals saw to that



set. But he could "chin" himself on the horizontal now serving his country as a fireman in the Navy

He had flat feet—that's obvious. According to the medical rules he must be rejected. So they tested him. He hopped seventy yards on the toes of each foot. That was enough for Uncle Sam. He's in the Navy now

A Doll Factory Looks Like a Dissecting



Most dolls come in sections, as pictured below. Here, the trunk, arm and leg halves must find their mates before they are glued together for life. After they have been properly joined the rough edges must be smoothed off

Photos © Press Illustrating Serv.

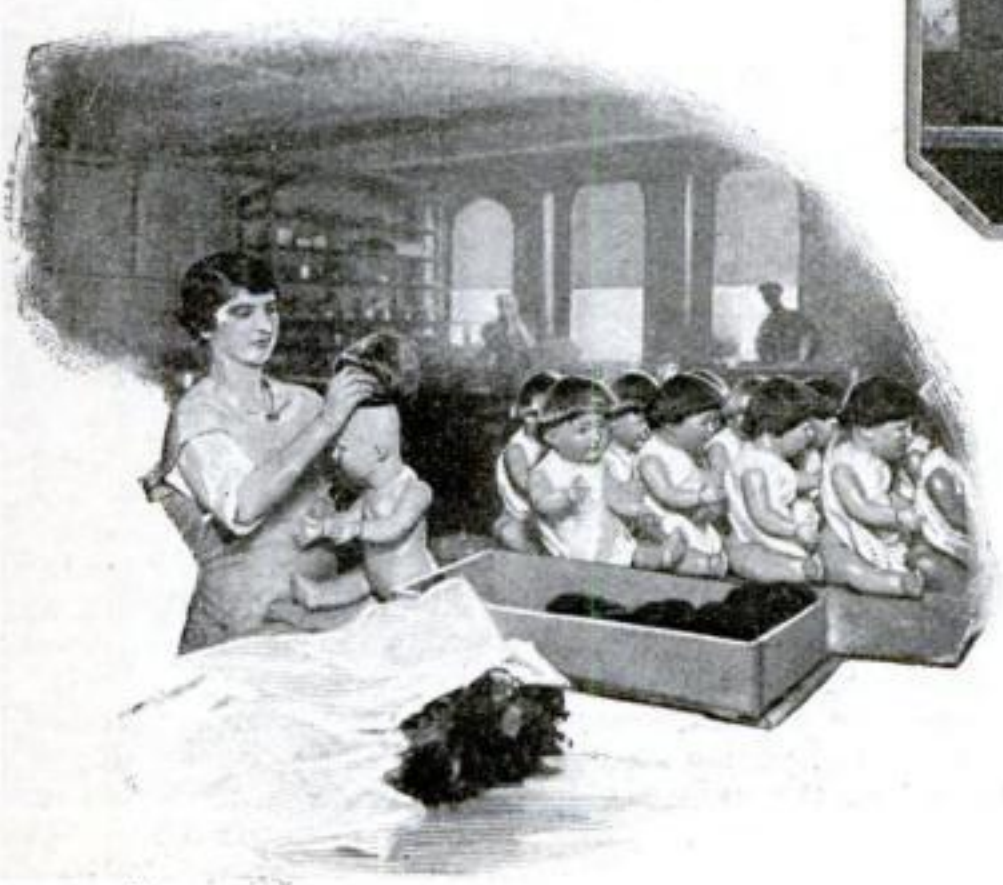
The workman above is dipping the trunk of the doll into a solution which gives it a flesh-like tint and waterproofs it at the same time. Hanging on a wire at the right may be seen some disjointed arms, fresh from the dipping operation. Dolly now is impervious to baths

Dolls are famed for their peach-blow complexions. The secret of these perfect complexions is divulged here. A workman sprays on the delicate color with air. What a pity that the human skin can't be treated in the same way; and be given a lasting rosy bloom. Eyebrows and lips are next painted on and then the eyes are placed in position

Laboratory—But Don't Tell the Children

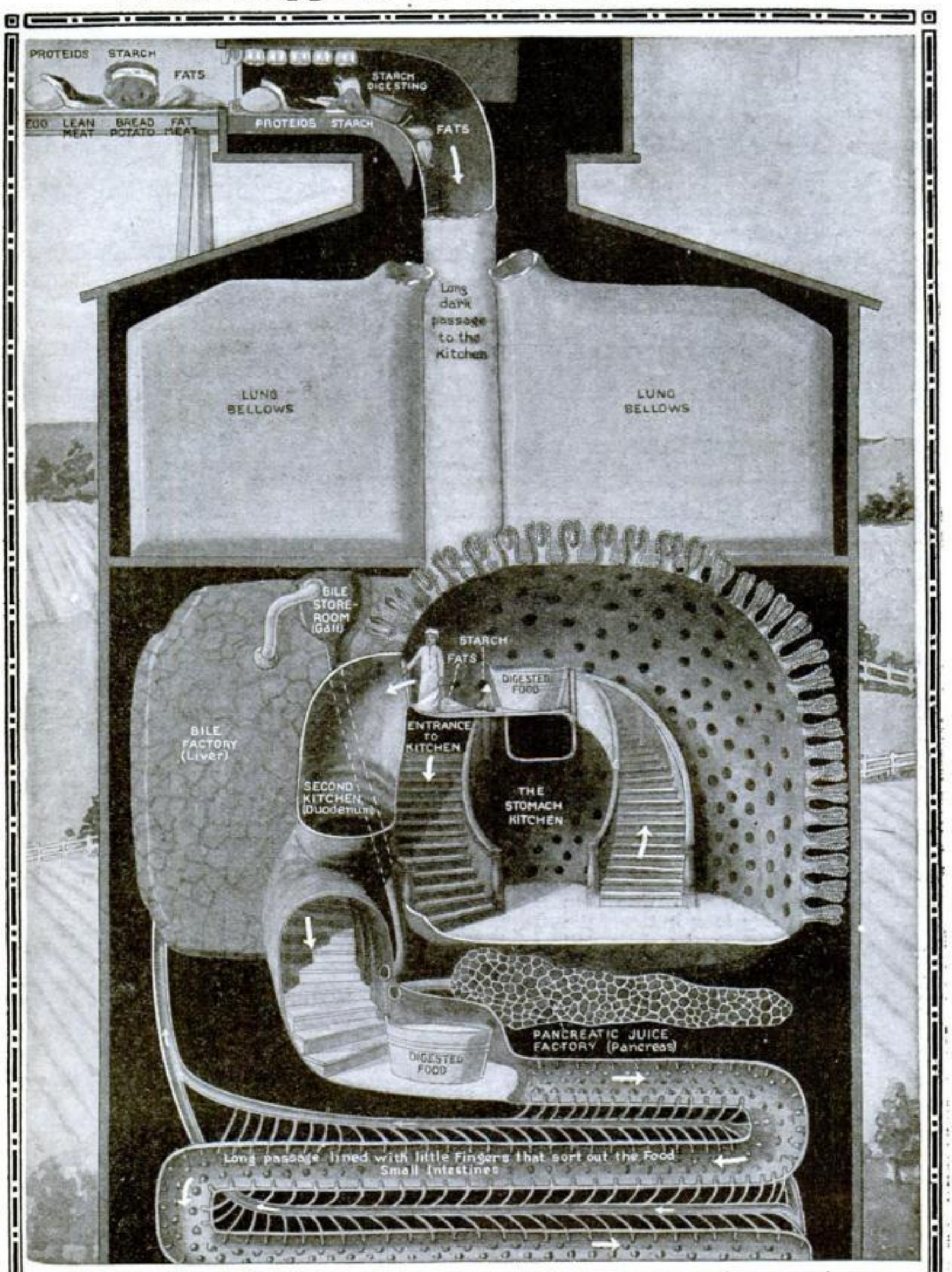
On the table above, the parts of the doll-to-be are beginning to assume familiar shape. The legs, at any rate, have found their mates and all that remains to make them passable is some very careful smoothing and polishing

A doll with a bald head is worse than no doll at all. Below, a bisque doll is receiving her crowning glory at the hands of a woman worker who does nothing else all day long but put the right shade of hair on the right doll



A collection of dolls, with 'Rastus, the human chocolate drop, thrown in for good measure. Dolls in winter dress sometimes make large money for their makers, because the head is left hairless and a woolen cap which costs little, is substituted

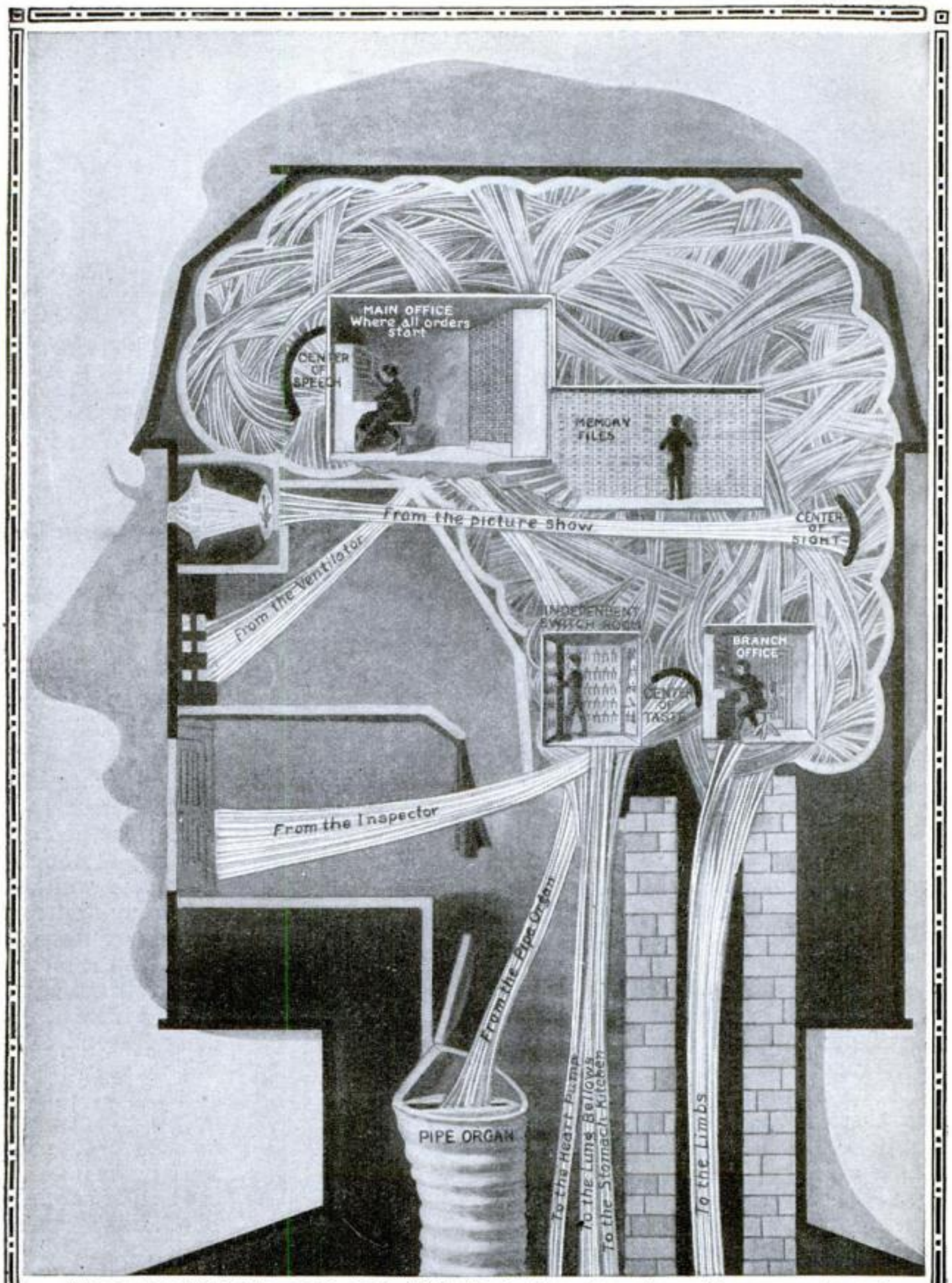
What Happens to the Food We Eat?



The above illustration shows the adventures of an egg, a piece of lean meat, some potatoes and a slice of bread during the process of becoming proteids, starch and fats. The egg and meat are shown just as they come to the "mill," unground, although of course we grind everything that comes into the "mill." The bread and potatoes begin digesting at once. The other food is slower, needing preparation in the first kitchen before passing to the second kitchen where the bile and pancreatic juice complete its digestion. As this food passes along that tube the little tentacles in its walls sort out what is needed, the waste going into the sewer. It takes two hours for food to digest; so we should not overcrowd our stomachs

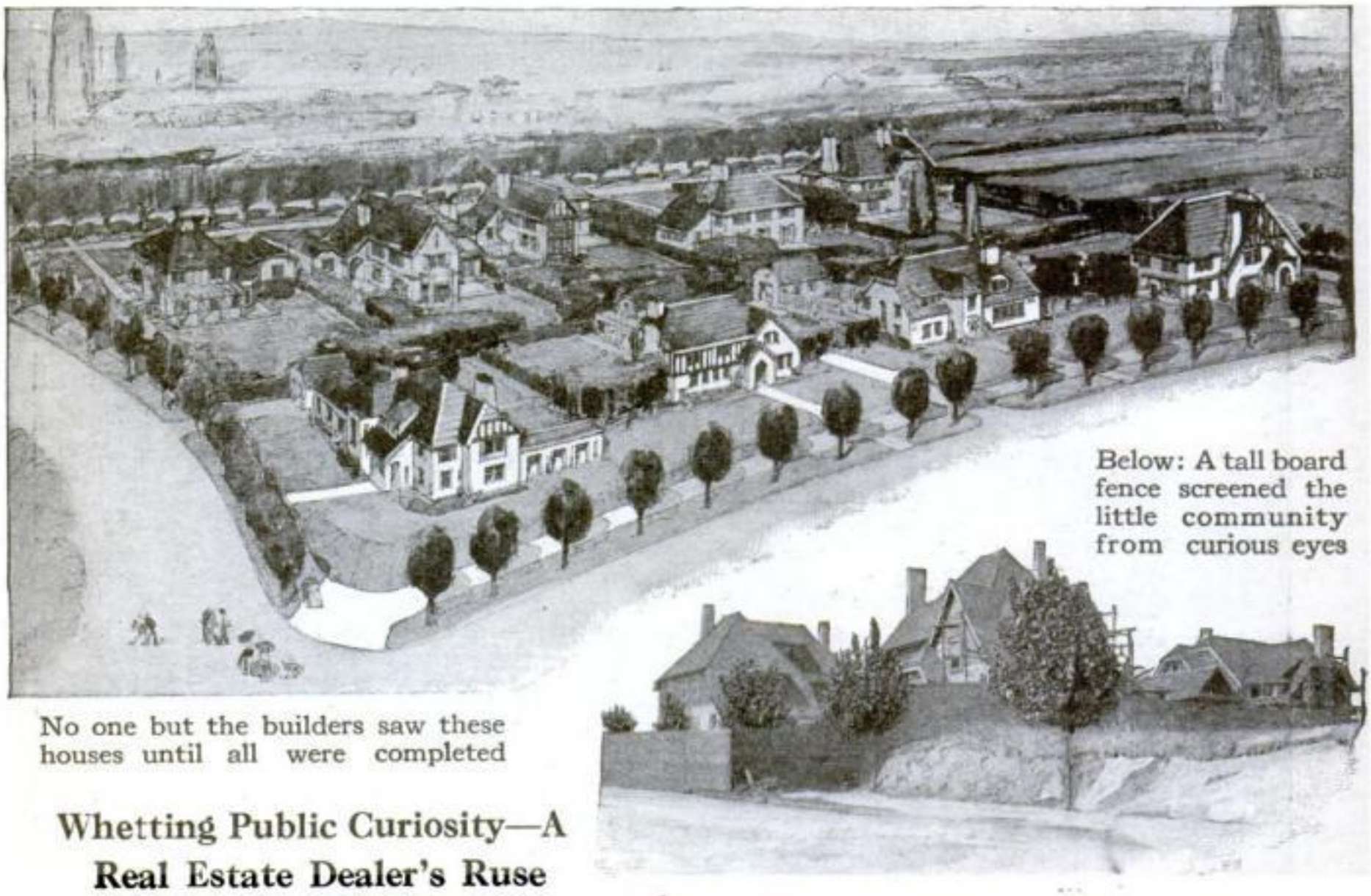
(From a drawing by Prof. and Mrs. Winfield Scott Hall in Pictured Knowledge. Compton-Johnson Co.)

Is Your Brain Completely Furnished?



"As a man thinketh—so is he." This illustration shows how all movements and functions of the body are controlled from the head. The brain conducts a busy telephone exchange, with a central office and many branches. Whether you want to walk or to sneeze, to sit down or just to go on breathing, the order must come from "the man higher up." Then, over the wires go instructions to the hands, legs or lung bellows. There is an independent switchboard which governs so-called involuntary action. You can easily locate the memory files, the picture show, and the ventilator. But can you find love or hate, fear or joy anywhere about the premises? "Where, oh where is fancy bred? In the heart, or in the head?"

(From a drawing by Prof. and Mrs. Winfield Scott Hall in Pictured Knowledge. Compton-Johnson Co.)



Below: A tall board fence screened the little community from curious eyes

No one but the builders saw these houses until all were completed

Whetting Public Curiosity—A Real Estate Dealer's Ruse

AN unusual method of building houses was adopted in a real estate development in Portland, Oregon. The builder believed that "familiarity breeds contempt." As he did not want anyone to have contempt for his houses, he corralled them until they were all done. As soon as he began building, he erected a tall board fence all around the property. The most curious person could not get a peep in. No doubt he saw to it that there were no knot holes.

This arrangement had all the elements of surprise which the public enjoys in attending the theater. Not until the houses were complete to the last little detail; not until the lawns were green and the shrubs all planted; was the order given to tear down the forbidding fence.

How a Los Angeles Newsboy Increased His Business

AN ingenious newsboy in Los Angeles, California, has devised a method of attracting attention to his wares which has not only interested passing persons but has been the means of sparing his voice, while greatly increasing his daily income.

The boy has constructed a sign, which is placed above his head so that it may be seen by persons who are at a distance from him. It is fastened to a wire, which is held in place by a belt which he wears around his waist. He has arranged two loops of wire, through which he passes his arms. This keeps the sign from falling either backward or forward.

How a newsboy saves his voice and yet "calls" his papers most effectively

Sweat Bands Use Fifty-Five Million Feet of Leather a Year

LOOK at the sweat band in your hat or cap. It is about two inches wide and twenty-five inches long—a little thing, you say. It takes an annual total of fifty-five million feet of leather to put this band in the headgear men wear. It is, in truth, one of the biggest little leather leaks brought to the attention of the public. But it is not a difficult leak to stop. By wearing hats or caps with substitute leather bands or no bands at all, you can divert the leather to more important needs.

Clearing the streets of London with an illuminated warning carried by automobile. After the danger is past, the reverse side of placard is shown telling that the way is clear

Protecting the Phonograph from Scratches During Transportation

THE phonograph cabinet is designed to be as ornamental a piece of furniture as the piano. The dealer therefore, realizes the importance of handling it with care. One company is employing a khaki moving-cover which is so designed that it makes the cabinets easier to handle and protects them from any danger of scratching, bumping or finger-marks.

This khaki cover is shown in the accompanying illustration. It is provided with strong straps into which the arms of the carrier fit, and other straps which pass under the cabinet.

There is also a loop by which the cover may be hung up when not in use.

Protected by its khaki cover the cabinet can be moved without danger of being marred even by finger-marks

The Paul Reveres of London Ride in Placarded Automobiles

ENGLAND has had so many air-raids that special provision has been made in the large cities to warn the people when the enemy airplanes have been sighted.

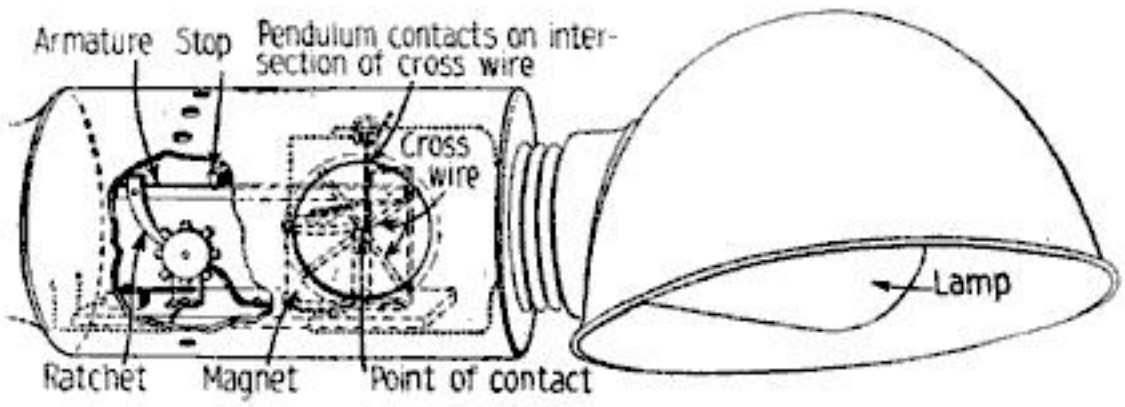
The illustrations show placarded automobiles sent out to give the warnings. The side lights are used to illuminate the signs, so that he who runs may read and get under cover. In a few minutes after the invading airplanes have been sighted, the streets of the city are without a sign of life. If a person should be at too great a distance from shelter to reach it, he drops to the ground. The signs are reversible, and on the opposite side of the "Take Cover" placard, the "All Clear" sign is displayed.

Maybe you have special needs. Write to the editor about anything within the scope of the magazine. He will be glad to help you.

Clap! Let There Be Light

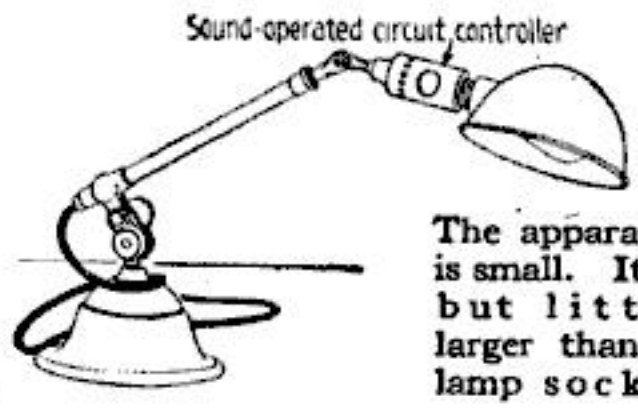
By clapping your hands you can light up the whole house. No, there is no microphone to hear the sound

SUPPOSE that you wished to light the electric light in the library while you were in the living-room and that you could do so by the clap of your hands. Or, on coming home at night, suppose that you could light your way by the same means without hunting for the electric light switches in the dark.



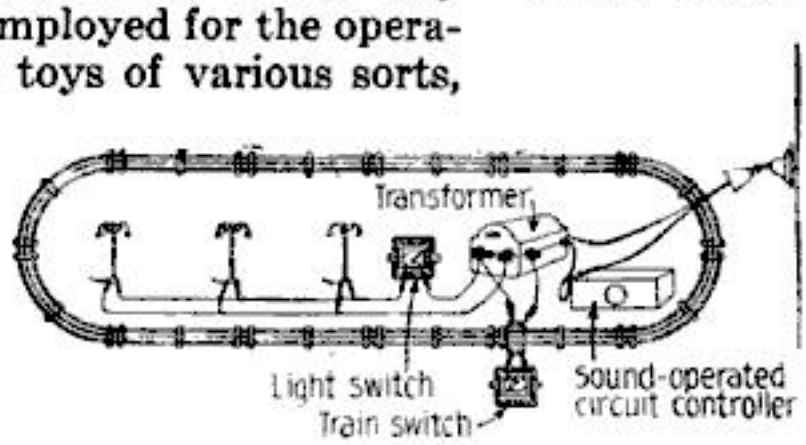
Noise of hand-clap jars a small pendulum away from diaphragm and breaks the relay circuit

But what's the use of supposing? Mr. H. Christian Berger, a New York city inventor, has made all such things possible by inventing a new contrivance which he calls a sound-operated circuit controller. Besides the utilitarian uses to which the device may be put, it may be employed for the operation of mechanical toys of various sorts, including electric railway trains, electric boats, hoisting derricks, or even the docile little wooden pup who jumps out of his kennel at your hand-clap command—a toy first described in the November, 1916, issue of the POPULAR SCIENCE MONTHLY.

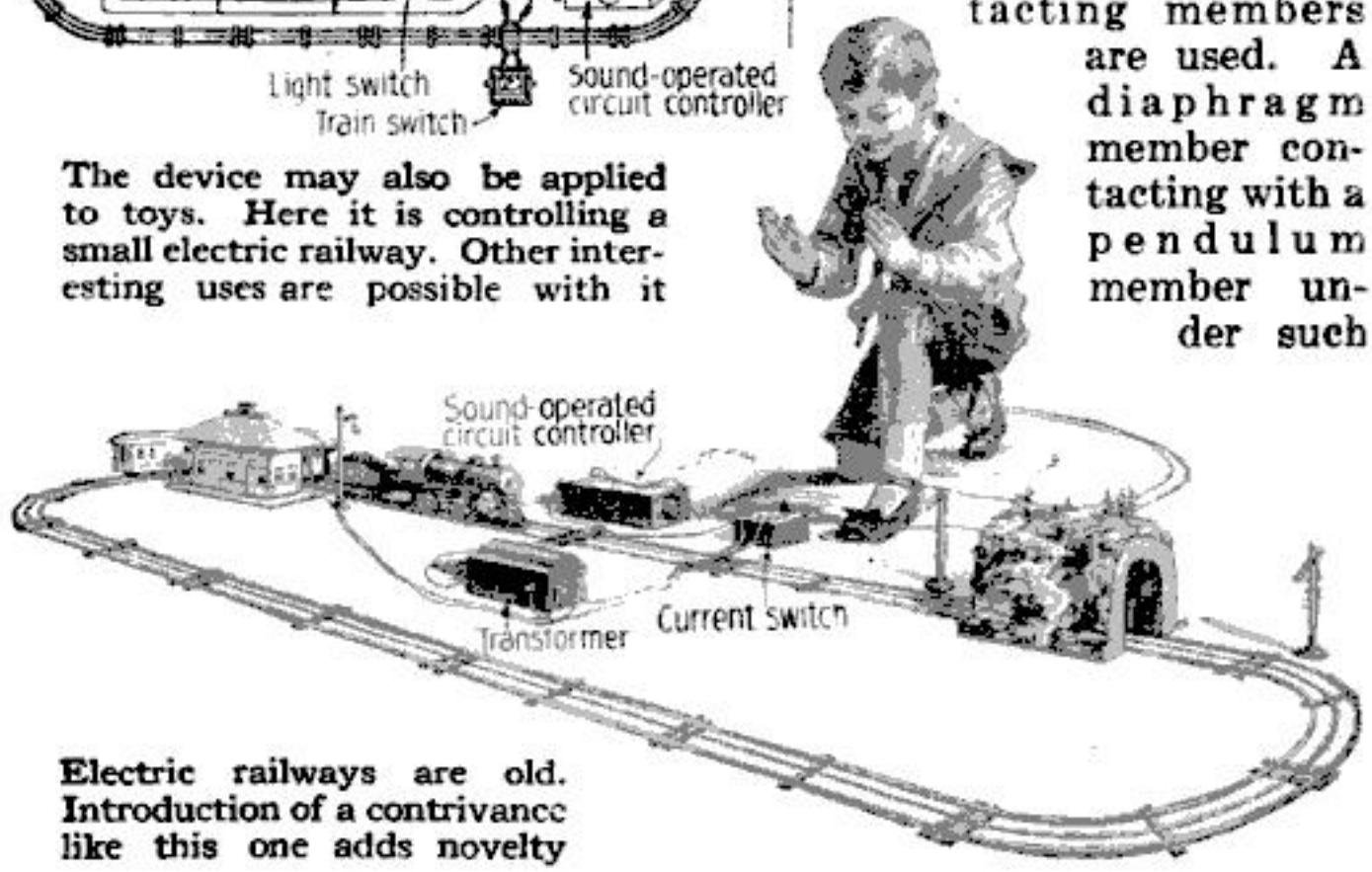


The apparatus is small. It is but little larger than a lamp socket

While the mechanical pup, just mentioned, worked fairly well, on occasions it would become disobedient and refuse to come out of its kennel, because of the variable current changes of the microphone mechanism, by which it was operated. The new means which Mr. Berger has invented to make the dog obey every command without fail, is based on an entirely new principle and one wholly different from that of the microphone. While the latter acts by varying the electric resistance and current in a circuit by changes of pressure and conductivity as a result of the action of sound waves—and does not break the circuit—the sound-operated circuit controller actually does open the circuit. These circuit breaks are made possible because two contacting members are used. A diaphragm member contacting with a pendulum member under such



The device may also be applied to toys. Here it is controlling a small electric railway. Other interesting uses are possible with it



Electric railways are old. Introduction of a contrivance like this one adds novelty

slight pressure that it is capable of bodily vibration by the energy of sound waves.

These two members may be employed in a circuit with a relay or other magnet whose armature is acted upon by a constant counter force or spring, the force of which may be regulated to move the armature beyond the operative influence of the magnet, or not, as desired. In the case of the toy dog, the force of the spring is such that the armature is thrown beyond the influence of the magnet so that the dog must be put back into his kennel by hand and placed up against the magnet bar before he is again ready to be clapped out.

With the electric train, the magnetic armature, instead of closing a relay circuit on each actuation serves to reverse it.

Sharpen Your Own Shears and Save Your Time and Temper

THE new grinding device, shown in the accompanying illustration, is designed to enable the barber, in a small town, to sharpen his own shears. It makes it unnecessary to send many dulled shears to a barber's supply house at a distance with the resulting delay. The new device is portable and may be screwed to the edge of any table, where it is ready to be used.

Barbers may now sharpen shears with ease and sureness of result

The contrivance consists of a small grinding wheel mounted on a vertical shaft. A crank and worm gear supply the power. The pair of shears is held in a clamp at the top of the wheel, as shown. The clamp slides on a metal rod so that the shears may be drawn across the face of the grinding wheel as it is revolved.

A Horn of Natural Rock. It Can Be Heard Six Miles

"KING ALFRED'S Horn" is the name applied to a great shapeless block of stone in the Vale of Berks, England. It is pierced with a number of holes. By applying his mouth to it and blowing as into a horn, the practiced performer can produce a weird, booming sound, said to be audible for a distance of six miles. The story goes that King Alfred used this natural horn to summon his forces for a great battle, fought in the immediate neighborhood.

The Trunk-Smasher Is Foiled at Last by the Rubber Mat

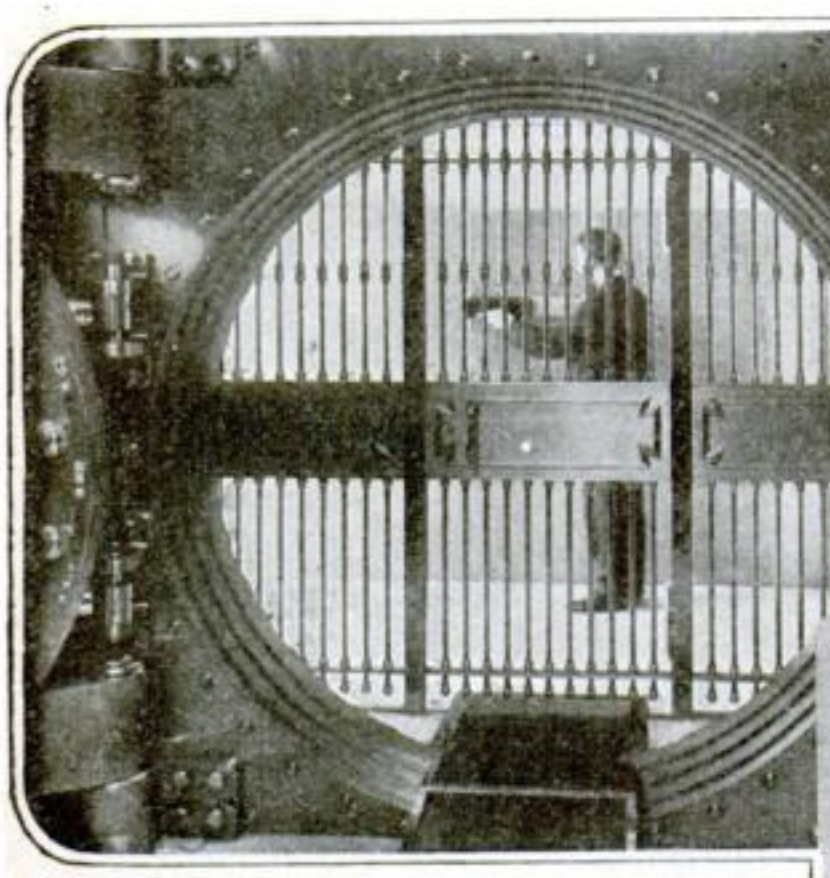
NO matter how strong and well built a trunk may be, it will not long survive if the average baggageman gets a chance to "strafe" it. A Los Angeles man would get around this by providing rubber mats for trunks to land on.

Trunks land on rubber mats in Los Angeles. A local man makes the mats of old garden hose

According to his plan, the mats may readily be made of heavy garden or other hose held together by a pair of rods. Using these mats, the baggageman may handle trunks with his usual roughness without injuring them.

Where New York's Bond Money Went

The huge safes of the Federal Reserve banks are proving most convenient in conserving all the Liberty Loan funds



Photos © Brown and Dawson

It takes both officers and clerks of a Federal Reserve Bank in New York city to get this door open. Each knows part of the combination. The safe also has a time lock

The fifty-ton weight of the door does not prove difficult to manage —one man can easily swing it open. But when the combination is "off" not even the Kaiser could get in earlier. Hence if the time lock is set for eight o'clock in the morning no one could open the door during the night. The longest time for which the time-locks can be set is seventy-two hours. This allows the door to be locked from Saturday noon, over Sunday and any holiday which might fall on Monday.

Each of the bolts set round the door weighs ninety-five pounds. They slide into place when the door is shut, securely fastening it at every point. The door is hung on its hinges in such a manner that despite its great weight it can be swung open or shut as easily as any ordinary wooden door. It is not only designed to thwart the skill of the experienced cracksman but to withstand the terrific heat and blows which accompany fires and earthquakes. After San Francisco lay in ruins, an early investigation of the big safety vaults brought out the reassuring fact that the contents were safe and intact.

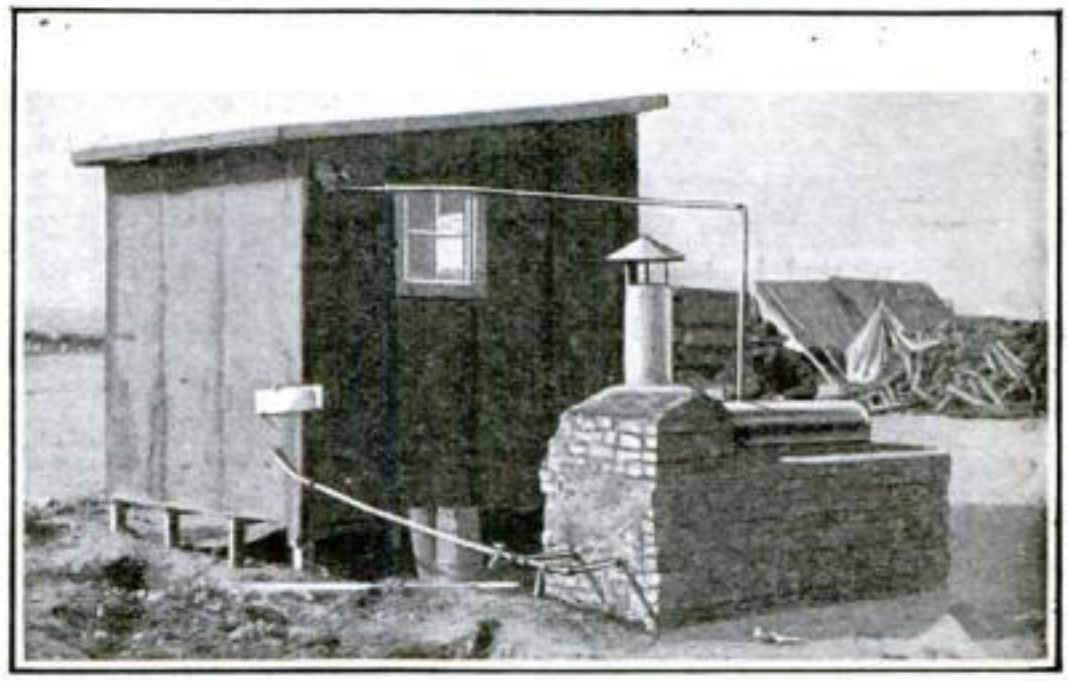
THE door in the picture weighs fifty tons. It guards the treasure of a Federal Reserve Bank—this particular one being in New York city. Liberty Bond money accumulates in Federal Reserve banks temporarily. The outer rim of the safe—up to the place where the bolts are placed—is constructed of manganese steel, which is particularly difficult to drill and which will not rust readily. When closed, the door fits so snugly that it is absolutely watertight.

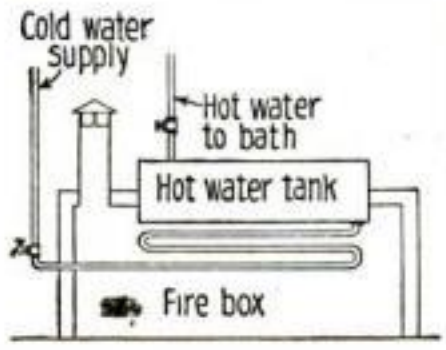
There are two combinations to the door. One is known by the officers of the bank and the other by the chief clerks. It is impossible to open the vault unless a man from each group is present. Four time locks control the mechanism. Once the time is set at which the door can be opened, it is impossible, even for anyone knowing the combination, to open it

The Federal Reserve banks have proven an almost indispensable aid to the floating of the Liberty Loans. They act as great central "warehouses" for the storage of funds, and also exert a stabilizing effect on banking and financial operations.

Unaccommodating Wells—They Yield Water Only at Night

IN the desert of western Australia there are wells which yield water only at night. Before the water begins to flow, weird hissings and the sound of rushing air may be heard. The phenomenon is believed to be due to a change in the form of the rocky channel through which the water flows, and to the extreme change in temperature between day and night which occurs in this region. The hissing is due to the escape of air before the advance of the water.



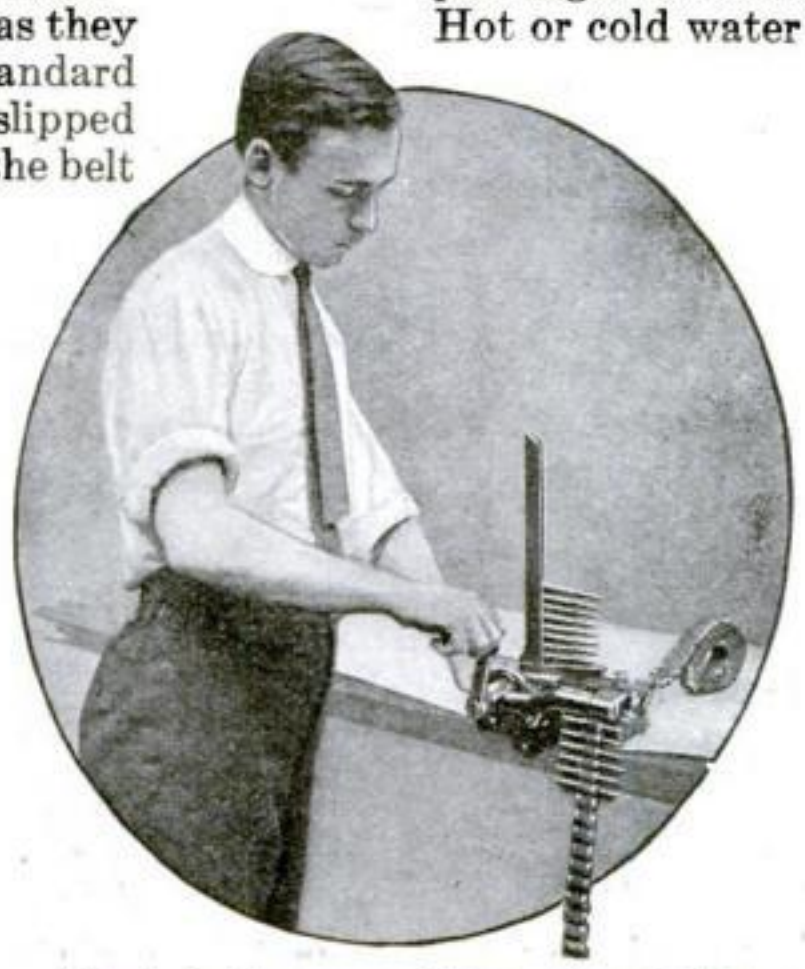


Using an old hot-water tank, pieces of pipe and other scrap metal, plumber-soldiers in the Eighth Pennsylvania constructed a shower-bath for themselves

At Each Turn of the Crank, a Cartridge Slips Into Place

AN automatic machine-gun can discharge the two hundred and fifty cartridges of a fully loaded belt in less than twenty-five seconds. The loading of the cartridge belts is, in comparison, a leisurely occupation. To slip two hundred and fifty separate cartridges, by hand, into their individual loops in the cartridge belt, is tedious and expensive. To expedite matters, the little loading device, here illustrated has been evolved.

Layers of cartridges, as they are removed from the standard box of cartridges, are slipped into the vertical guide, the belt entered between the feed-wheels of the loading device and the crank turned, just as one would operate the handle of an ice-cream machine. The cartridge belt issues on the near side with a cartridge properly inserted in each successive belt loop. In a very few minutes the belt is fitted with its complement of two hundred and fifty cartridges, and is ready for immediate use.



What is the man doing—sharpening pencils? He is not. He is loading a machine gun cartridge belt with rapidity

Plumbers Will Plumb—Even in Army

IN the Eighth Regiment, Pennsylvania Infantry, there are plumbers. Plumbers will plumb even if they *are* in the army and can't go back to the shop for tools. Ingenuity always takes the place of implements, as it did in this Eighth Regiment.

A few old pieces of pipe, some brick, a tank, and odds and ends, were all that was needed to rig up a shower bath for fellow soldiers. How the parts are put together is shown in the illustration. Hot or cold water may be had as desired. Real mortar is used in the furnace's construction, and over the whole is a coating of mud to help keep in the heat. Fresh water enters through the coils next to the fire and is made hot as fast as drawn out through the pipe leading to the bath.

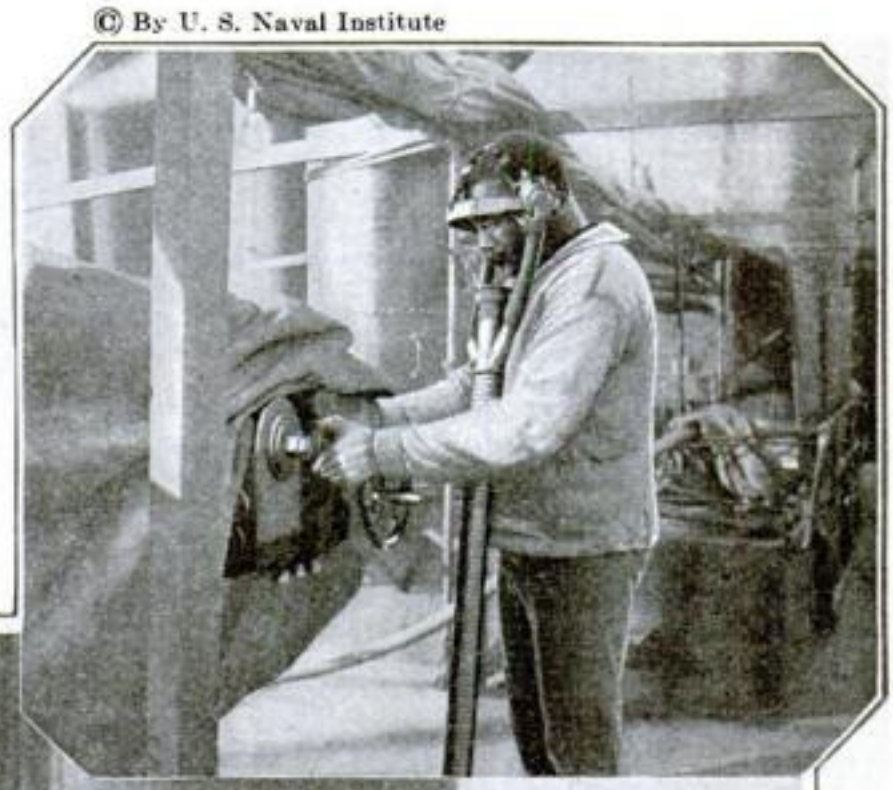
The soldiers may retire to this improvised bath room at any time and enjoy a hot shower. A fire of old fagots, pieces of coal, or anything available, will keep the water warm for a long period.

Speaking Tubes for a Ship's Gunners

Reporting the range, the hits and the misses

Photos by Naval Constructor Elliot Snow, U. S. A.

IN a naval battle, the range is obtained principally by men stationed in the mast tops. The readings of their instruments are telephoned down to the officers in the plotting room, below the warship's deck. Here the instrument readings are quickly transcribed into terms of gun ranges and of angles of horizontal deflection. These calculations



A receiving and transmitting headset as well as a speaking tube is shown at right

Above: A torpedo tube operator with the voice tube outlet beside his ear

A sight-setter's voice tube equipped with a megaphone attachment, at the left

are sent to the gunners through speaking tubes, although telephones and numeral indicators are often used, to make sure that the orders will be understood.

For when the battle waxes hottest, either a voice tube or a telephone is likely to be swept away. In big battles, the gun that has but one channel of communication stands grave chances of being cut off from the rest of the ship. Should that happen,

the gunners would have to depend upon the gun's telescopic sights, and there would be no checking up of hits or misses by the spotters in the mast tops.

Thus, the means of communication is the crux in the modern method of pointing and firing a battleship's guns. In our Navy, voice tubes are generally preferred to electrical apparatus. Speaking tubes are just metallic pipes made airtight.

Why Do You Laugh When You Are Tickled?

ALTHOUGH it is usually done in fun, the habit of tickling is supposed to be a somewhat dangerous one, according to physicians. The ticklish areas are located over the least protected parts of the body, where delicate vital organs are to be protected. The reason for the ticklishness is that the skin is highly sensitive there and "aware" of intrusion, as a means of protection from possible injury.

This sensitiveness, or awareness, the physicians say, is a relic of the days when man's prehistoric ancestors had to guard their lives constantly against creeping insects and the heavy penetrating pressure of animals' teeth. That is why, according to this theory, the tickle reflex is elicited principally by a light running motion over the skin, and by sudden prods.

The reaction, in this age, is a violent discharge of energy in the form of laughter and efforts to be free. But it is easy to imagine the shrieks of terror or pain that might have been the forerunner of the laughter. Humanity takes ages to outgrow its prehistoric impulses.

From Illustrated War News

The highly compressed gas in the "bomb," on being let out through the "buoy," forces out the combustible oil with it

The Liquid Fire of the Trenches Is Not as Deadly as It Looks

THE effect of jets of liquid fire on men in the trenches is more terrible to the eye than to the body. But despite this fact, it is still used as a weapon. The bulky, rectangular tanks found in the original outfits have been replaced by the less cumbersome and more efficient "life buoys" and "bombs" of the latest flame projectors. In operation, the Germans let out the gas under compression, so that it forces a stream of combustible oil from the buoys through a connecting line of hose. The oil, which travels fast under the great pressure, passes a lighted wick in the nozzle of the hose. The burning jet is then directed toward the enemy.

But improve their apparatus as they may, the Germans have no control over the action of the air. By lying flat at the rear of their trenches, the men, being attacked, are in little danger. It is the German soldier who has suffered most from fire. The British, in self-defence, have combated liquid fire with the flaming shell. This, as explained in the October issue of the POPULAR SCIENCE MONTHLY, does not ignite until it hits the ground. If the guns are pointed so that the shell strikes just in front of the trenches, both flames and débris will shower over the enemy troops. Moreover, the British have found that by firing at the enemy's tanks, these are often exploded, killing their operators in the action.

Blindfolded recruits learning speed in laying wire entanglements by the sense of touch

Training "Tommies" to Lay Wires in the Dark

IN efficiency tests, conducted at Aldershot, England, the recruits are drilled in every requirement of military tactics, under conditions such as they are likely to encounter in the war zone.

The accompanying illustration shows a wiring party, sent out to set up wire entanglements, presumably under cover of darkness. In order to train them to be sure of step, even when the way is obscure, the soldiers are partially blindfolded. Even so hindered, they work rapidly over rough, undulating ground, such as they will find on a battle field.

Moving a Piano by Automobile

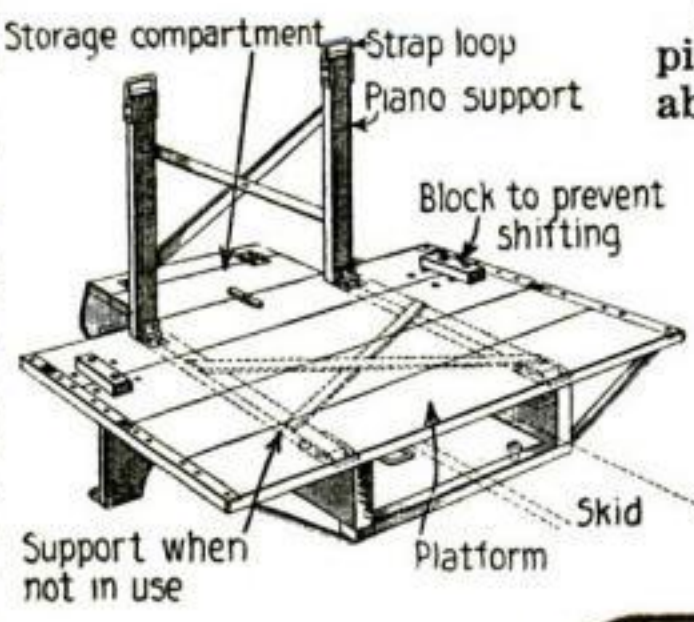
A NOVEL type of platform has been designed by a Nebraskan inventor, to carry a piano so as to properly distribute its weight over all four wheels of a Ford roadster.

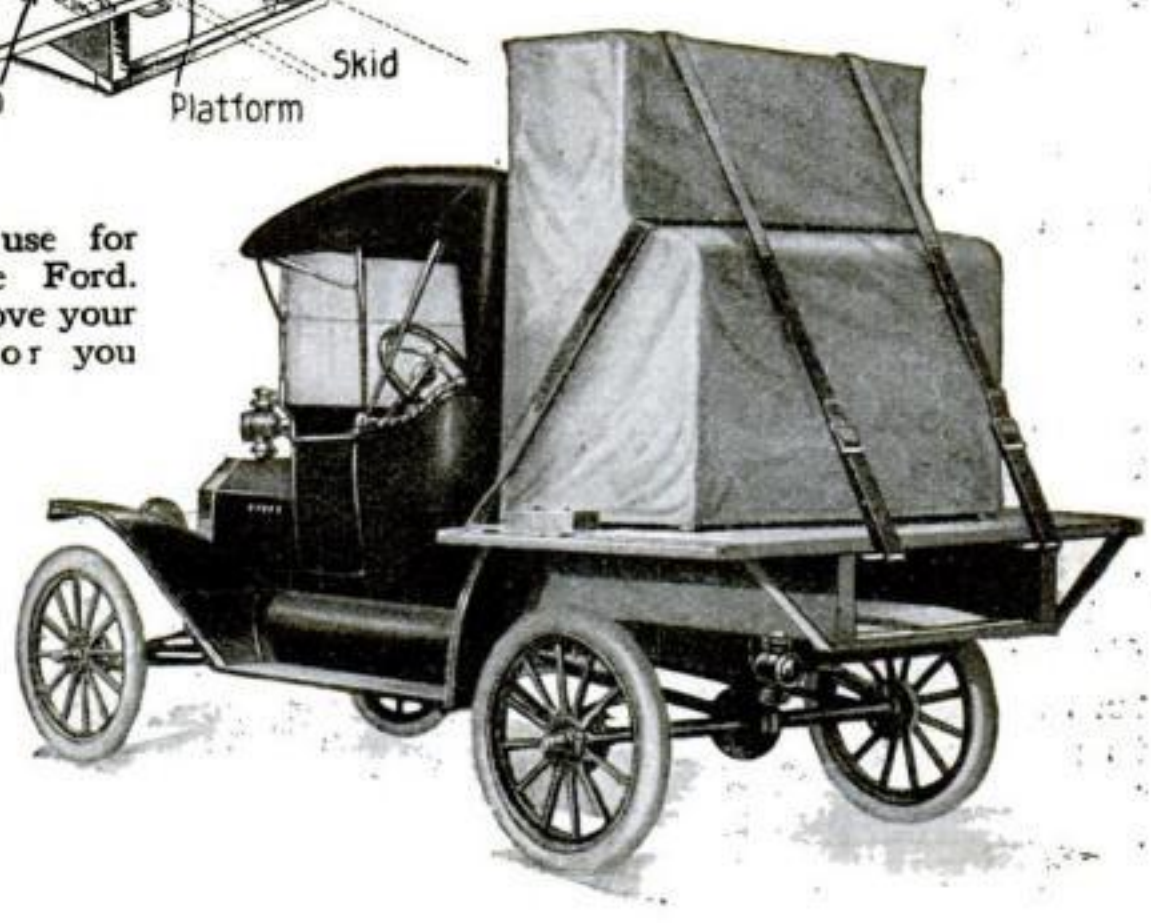
The platform is made of two longitudinal wood members curved at the front to fit the rear end of the Ford seat, and held in place by means of bolts through the top and bottom flanges of the Ford side-frame members. It is suitably cross-braced and has side brackets by means of which it is attached to the runningboards to secure greater rigidity.

The platform is made of wood, reinforced with angle-irons on the edges, and near the front it has two hinged boards, which are raised to a vertical position when a piano is carried.

The piano is placed transversely of the Ford with the keyboard at the rear. It is held in position by means of two leather or canvas straps, inserted through loops in the tops of the two hinged boards and then carried back to the rear of the platform, and by means of an additional leather strap, inserted in the angle of the keyboard, and attached to the front ends of the platform on either side.

Since the weight of the average piano is approximately 350 lbs., or about equal to that of the three passengers usually carried in a Ford touring model, no additional strain is placed on the vehicle. The piano is placed directly up against the two hinged boards so that it can-





Another use for the little Ford. It will move your piano for you

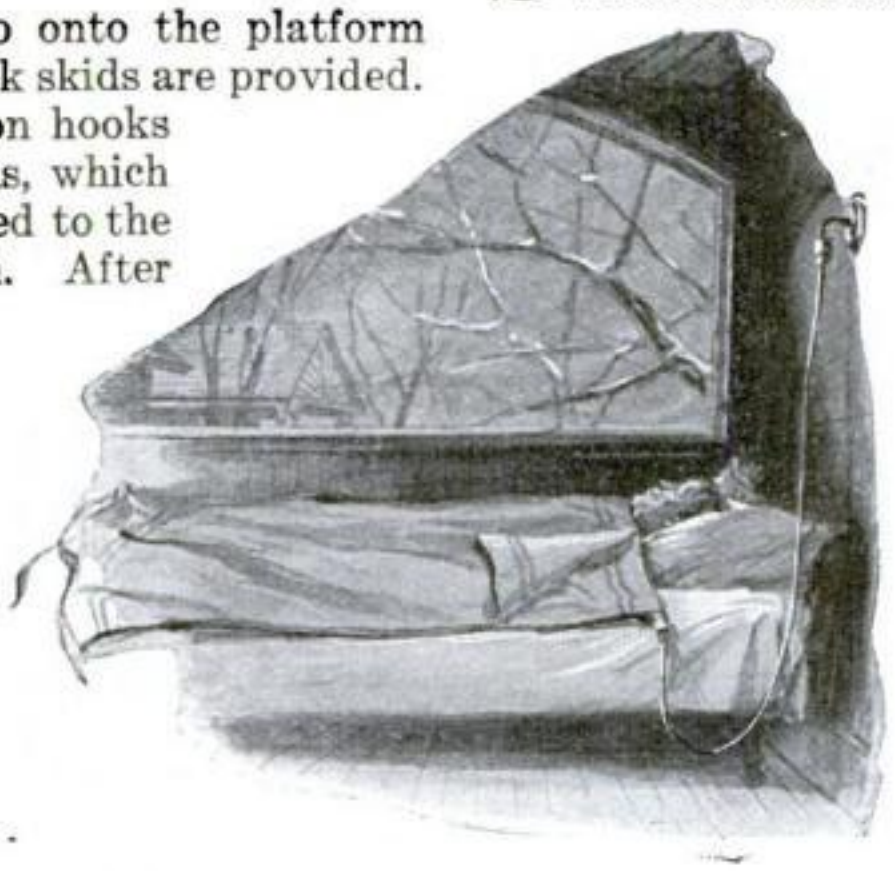
not slide while the vehicle is in motion. Its center of gravity is well forward of the Ford rear axle in order that its weight may be partly distributed over the front wheels.

To load the piano onto the platform easily, two stout plank skids are provided. These have angle-iron hooks on their forward ends, which slip into staples bolted to the rear of the platform. After the piano has been loaded, the skids are removed from the staples and pushed forward under the platform, so that their overhanging ends do not present a menace to pedestrians.

In this way the piano is as safely moved as in a fully equipped van.

Lo! The Electric Blanket. It Always Keeps You Just Warm Enough

SLEEPING out-of-doors has been robbed of its most unpleasant feature—the chill. No longer is it necessary to shiver with cold, or to pile uncomfortably heavy bedclothes over yourself.

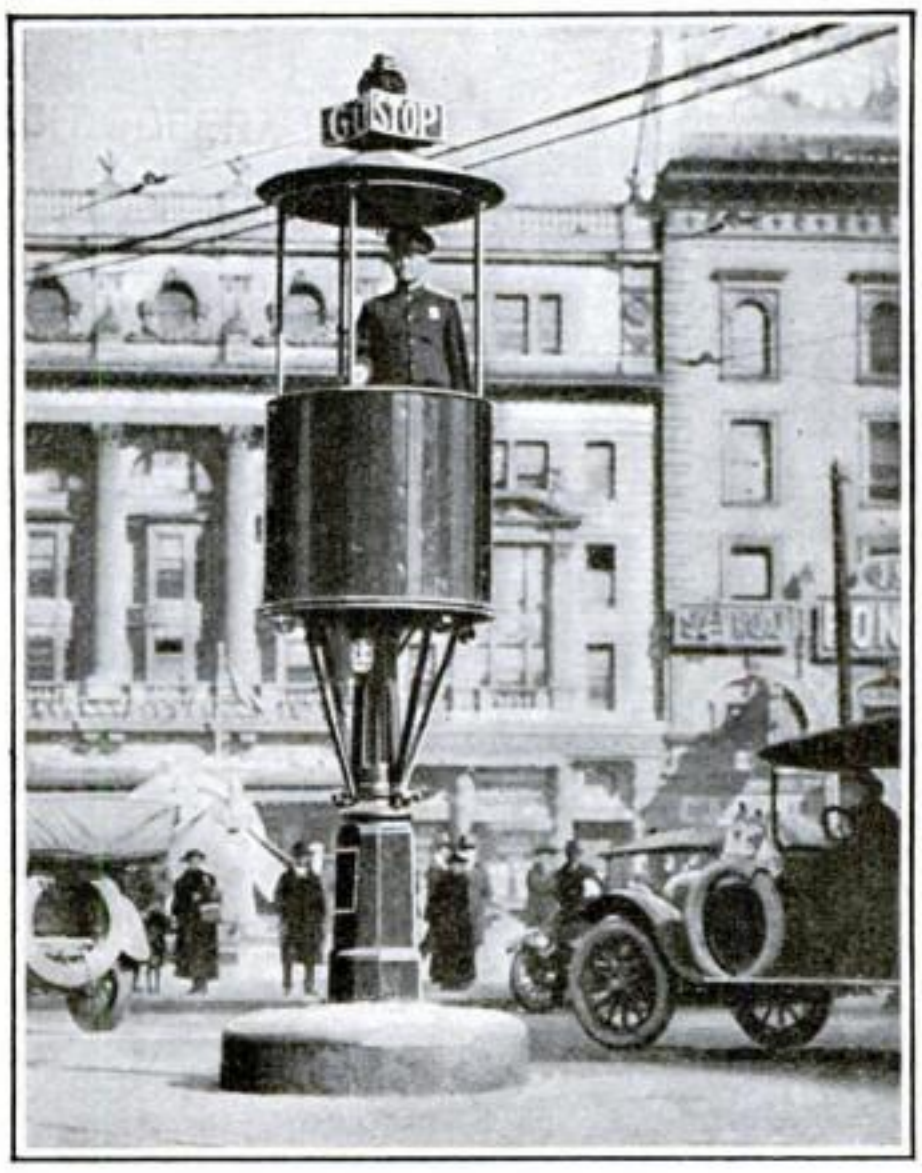


This electric attachment makes one blanket sufficient for the coldest night

An electrician has devised a light blanket which is electrically heated. The blanket is equipped with three heats, so that you can have it mildly warm, warm, or almost hot, with the expenditure of but a small amount of current.

No Passing Traffic Can Interfere With This Policeman's View

A PERMANENT nest of wood and iron construction, standing more than fifteen feet high, at the intersection of six streets in the busiest part of Detroit; will be used by a policeman, to direct traffic going in twelve directions. In this nest the officer is high enough to see several squares each way, which enables him to avoid confusion and accidents. The station, which is glass enclosed and heated, has a signal equipment, so that it can easily communicate with nearby busy traffic posts.



An elevated policeman's nest, with the direction indicators in clear view of all

What Causes the Singing of Telegraph Wires?

THE singing of telegraph wires is sometimes regarded as a weather prognostic, though opinions differ as to the kind of weather it foretells. There has been much discussion as to the cause of this sound. Probably it is simply the Aeolian harp effect, and its occurrence depends chiefly upon the direction of the wind in relation to the direction in which the wires run. Variations in the pitch of the sound depend upon changes in the tension of the wires with varying temperature.

Attaching and detaching the adjustable gun-locks

You Can Be Your Own Gunsmith

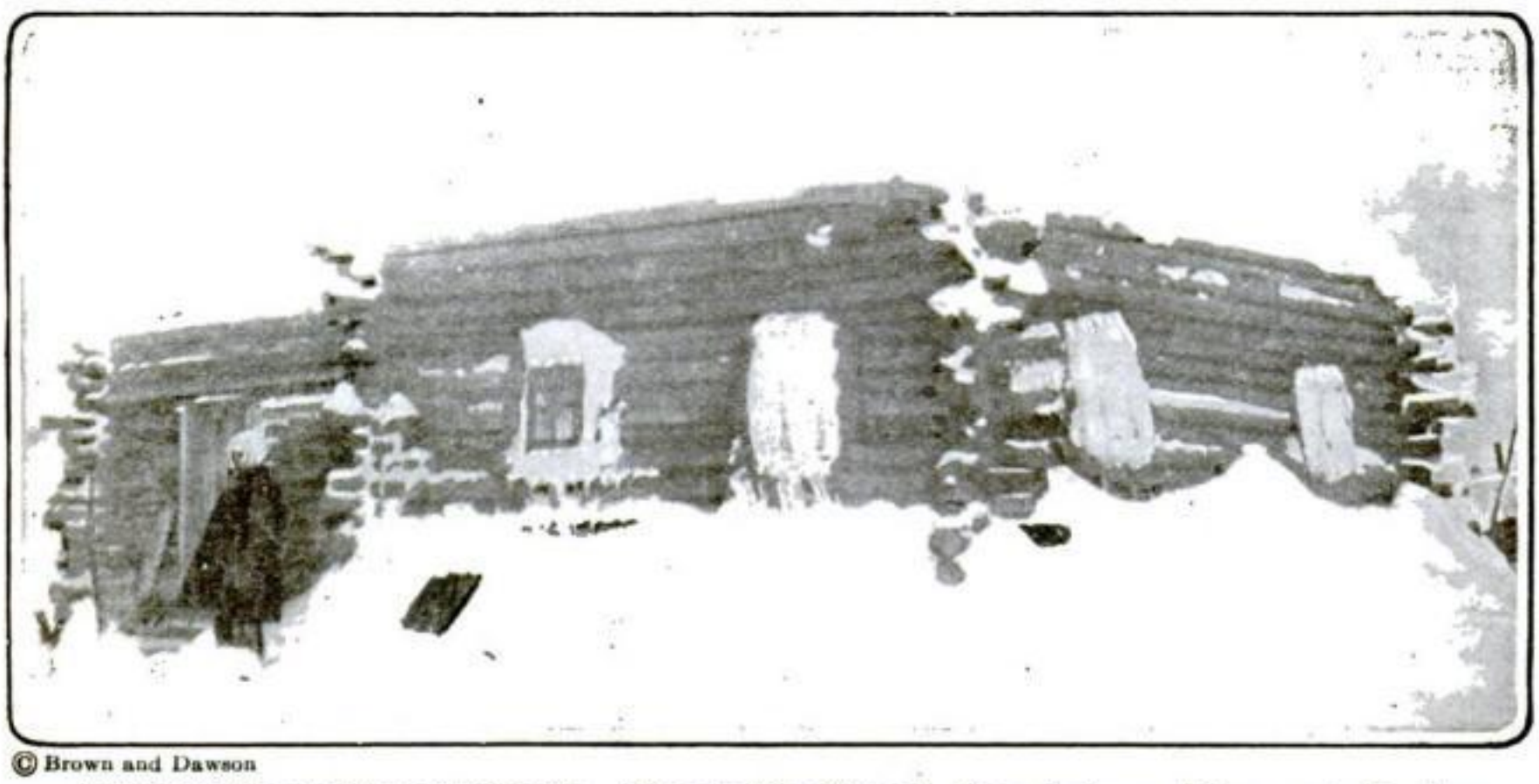
JUST about the time the merry gunner is afar from gunsmith and factory, and the ducks are coming in, his old fowling piece decides to take a vacation, and a lock quits. Maybe it is rusty through long neglect, maybe a firing pin has become gummed up, maybe a mainspring breaks. A seance by marsh, particularly salty marsh, or seashore, is likely to start a coat of rust on the damaskeened surface of the locks of a fine gun; or a primer may leak and let in gas, which starts rust also.

A British maker has evolved easily-detachable locks for the hammerless gun. Take off the fore-end, press back a catch, and the bottom plate in the frame of the gun drops down on a hinge, exposing the two fine locks of the hammerless gun, the main and sear springs, the sear, and the striker and tumbler of each lock. Only a moment is required to wipe them off, oil them and slip them back into the gun. Or if new parts are required, the maker furnishes them in a neat leather case. If anything should break, merely take out the old part and slip in the new.

Using Snow for Cement and Ice for Windows

FIFTY degrees below zero is the average temperature in the south of Siberia during the winter months.

In the section of the country where the house shown in the photograph was located, the weather is comparatively mild. In fact, although the logs of the house were cemented together with snow, there were times when repairs were necessary on account of the snow melting from the heat of the interior. The windows, too, which were of sheets of ice, had to be renewed at least once in every four months.



© Brown and Dawson

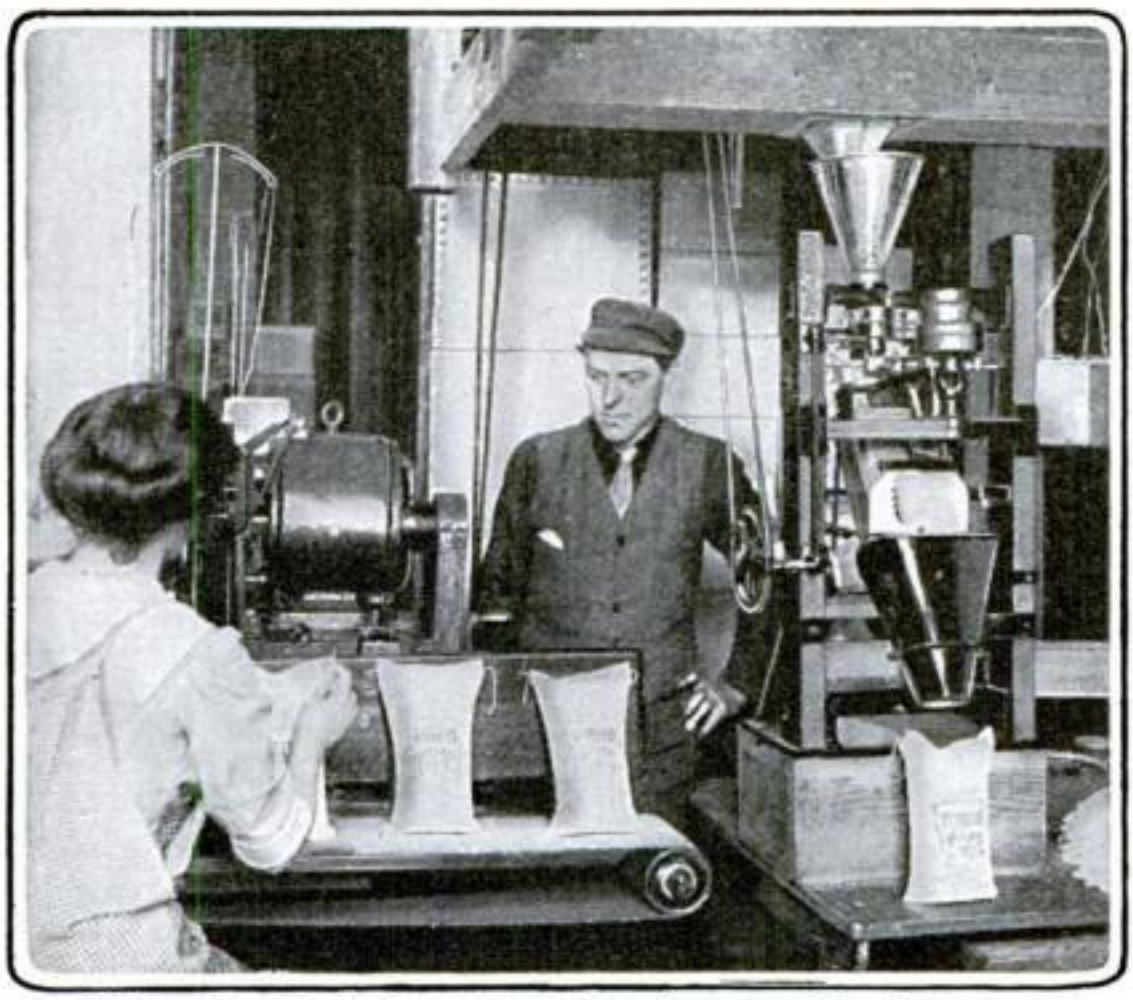
A fashionable residence in Siberia. The roof is of mud, the windows of ice, and the logs are cemented together with snow. If a sudden warm snap occurred the house would collapse

Weighing Goods Automatically

A machine that insures
the merchant against loss

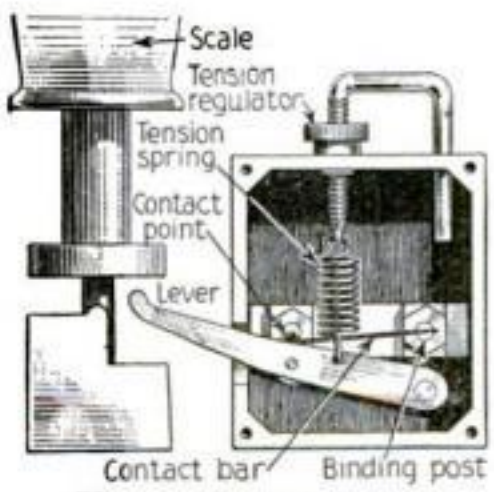
IN putting up package goods such as sugar, coffee and rice there are two sources of loss. One is undue waste of time in weighing the contents by hand filling, and the other is due to giving overweight.

Consider first—the weighing by hand. A good clerk can weigh only five or six packages a minute, and experiments show that each of the packages contains a "present" for the purchaser, of half an ounce or less of the commodity.



When the desired amount has been weighed out, an automatic cut-off is operated which prevents waste

Some merchants have tried the plan of setting the scales to weigh short, trusting to correct the overweight in this manner, but this is by no means accurate. This was proved by a test in a large grocery where that system was tried. Out of two thousand packages reweighed, it was found that over ninety percent ran overweight. Less than five percent showed underweight, although the scales had been set two ounces short.



How the weigher works automatically

An electrically-operated weigher has been produced to overcome this defect. It handles from fifteen to twenty-five weighings per minute. Its features are an even balance scale, agate mounted, a mechanical cut-off, tripped by electricity, which cuts off the flow of the commodity in full stream and a control box which allows for the amount in suspension; that is, the amount in the air at the moment the cut-off is operated.

The weight plate of the scales rests upon the lever, which is thereby depressed, and the electrical contact is broken. When the goods approach the weight required, the tension of the spring causes the weight plate to be raised a bit prematurely and contact is made by which the electric circuit is completed and the cut-off tripped.

All of the parts are made of the highest quality of metal, to prevent inaccuracy due to wear. The tension screw is adjustable, so that it can be regulated to allow for all conditions, even for weather, which might cause a variation in the flow of the commodity. A test weight is used and then the standard of accuracy is divided into three parts, high, low and exact balance. The machines are self-testing, so that the need of adjustment is quickly made evident, and their regulation is easily accomplished even by an unskilled operator. Thus extreme accuracy as well as high speed in weighing package goods is secured. On the other hand, automatic weighers of many designs allow for practically no inaccuracy.

Dolls Become Screen Idols

They never get stage fright and they don't talk back

Photos by Peter Pan Film Corp.

Here we have a kitchen romance acted by dolls. The cook is embraced by her sailor sweetheart much to the horror of the butler

HARASSED motion picture directors may be relieved to know that there are stars who will do exactly what they are told to do without complaining. These quiet, obedient actors are dolls. Yes, dolls have not been able to resist the lure of the screen.

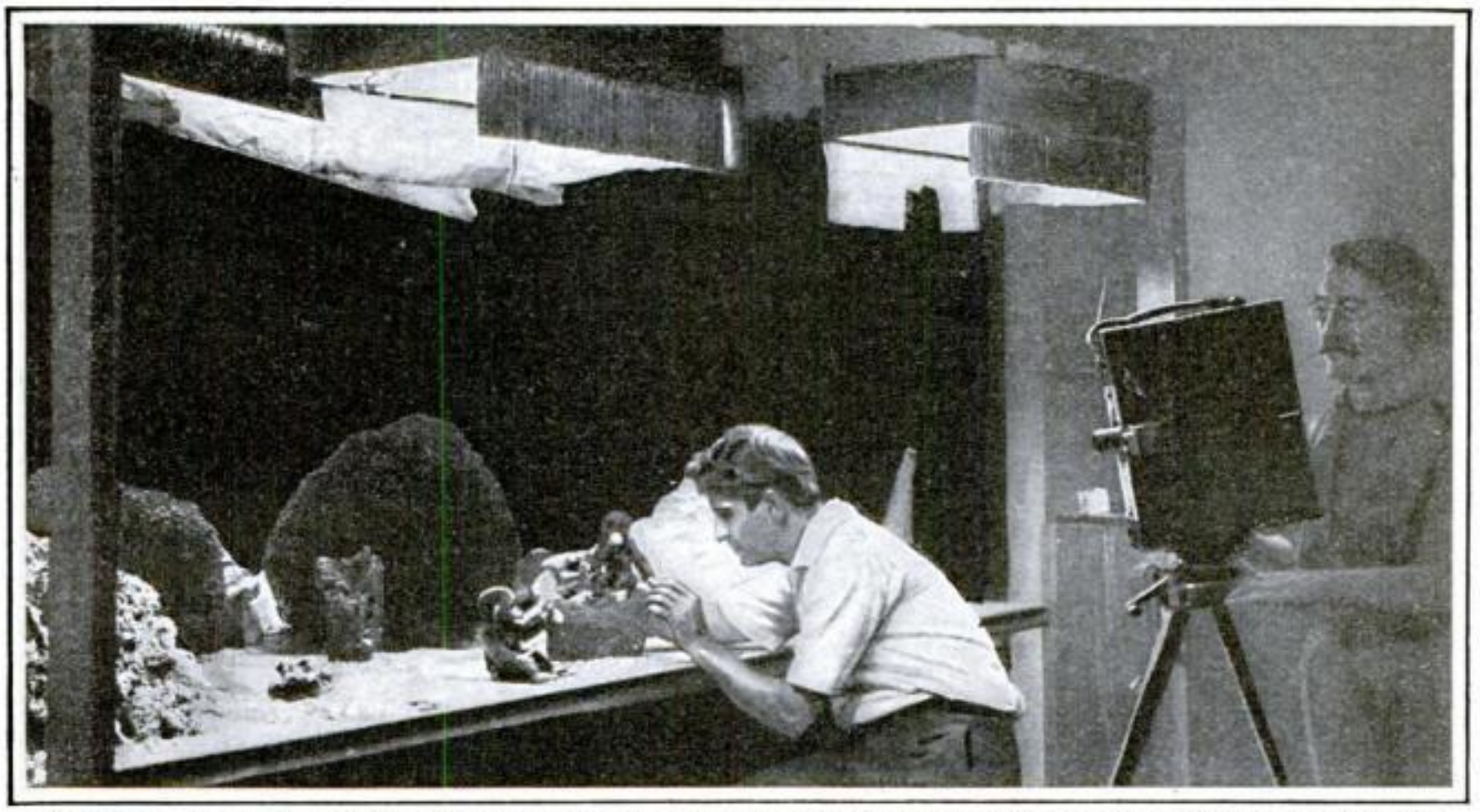
They are just the ordinary, little dolls such as any child would like to have for playthings. A special stage and scenery is constructed for them. They are put through the poses which make up a real drama. The work is tedious and requires any amount of time. The dolls are posed and a picture is taken. Then they are moved a fraction of an inch to a different position and posed again. The camera takes another picture. When the work is finally done, the dolls appear to move across the stage with all the rapidity and ease of motion of real actors.

The plays which they act in are not meant to appeal only to children. The dramas are well thought out and clever enough to interest any motion picture spectator. But as the work of posing them is so very slow, a scenario played by dolls is, in some ways, more difficult to put on than one played by human beings. It often takes several weeks to make a short play. For example, if a scenario called for a real actor to throw his arms about the leading lady, the actor would be able to go through the motions in one or two seconds. This would be recorded on one or two feet of film which would comprise from twenty-four to thirty-two pictures.

When the same scene is acted by a doll it requires from twenty to thirty minutes, even at fast work; for the doll actor can be moved only a fraction of an inch at a time. The director must understand just how to make his toy actors move in a realistic manner. In other words, he must have studied and been a keen observer of human motions. When we see a man step up on a chair, the step is taken in one swift movement. If a motion picture doll steps up on a chair, this step requires a whole series of movements. The doll is posed ready to step up. It is then suspended by an invisible wire and raised until ready to transfer its weight to the chair. All this must be done in such a manner that the simple act is executed smoothly and naturally.

The director's work with dolls and the results he accomplishes are somewhat similar to the "animated sculpture" which first appeared several months ago. In this novelty plastic clay figures took the place of dolls.

The elopers have eluded the outraged papa of the flaxen-haired girl and they are about to sail for parts unknown



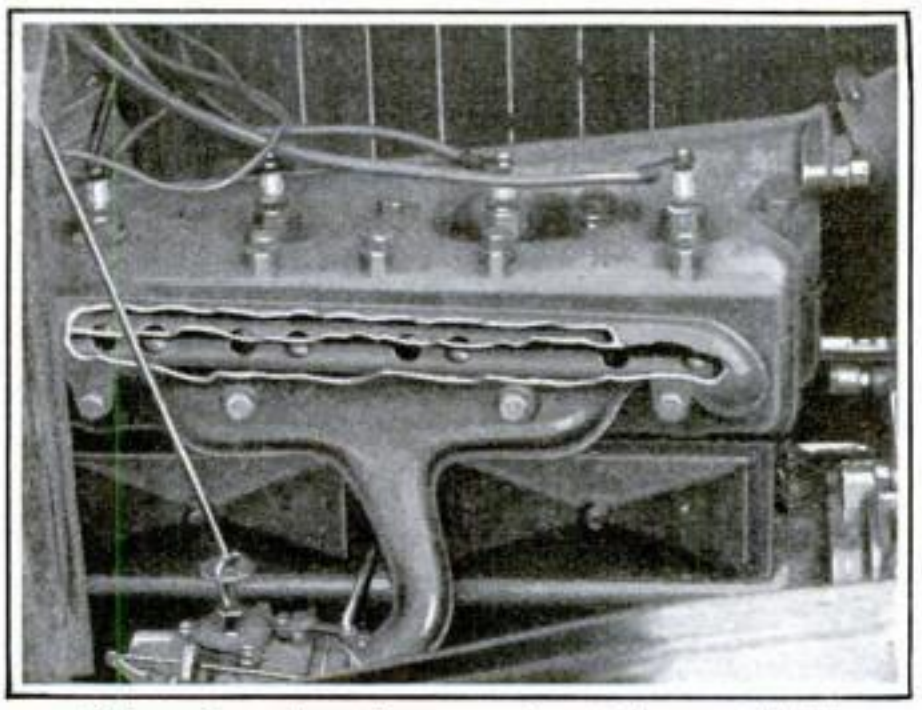
It is tedious work putting the doll actors and actresses through their parts, but the results are worth the efforts expended. The action depends upon the number of poses taken by the figures

The sculptured figures were changed to different poses and then photographed. In other words, each time a figure moved, a new pose had to be made. Think what that meant! For the ordinary reel of one thousand feet, sixteen thousand separate poses were required to furnish the action!

Automobile Fuel Heated by Exhaust Gases in Dual Manifold

THE use of heat is perhaps the simplest expedient to which engineers have resorted in an attempt to give the automobilist the same number of miles per gallon from the present-day gasoline as that secured from the better grades, sold several years ago. Present-day gasoline is more like kerosene than the gasoline of 1912. Kerosene has a greater fuel power than gasoline, but it is harder to get the power out of kerosene than it is gasoline because it cannot be broken up into its elements and turned into a combustible gas as easily without some external means. One of these is heat.

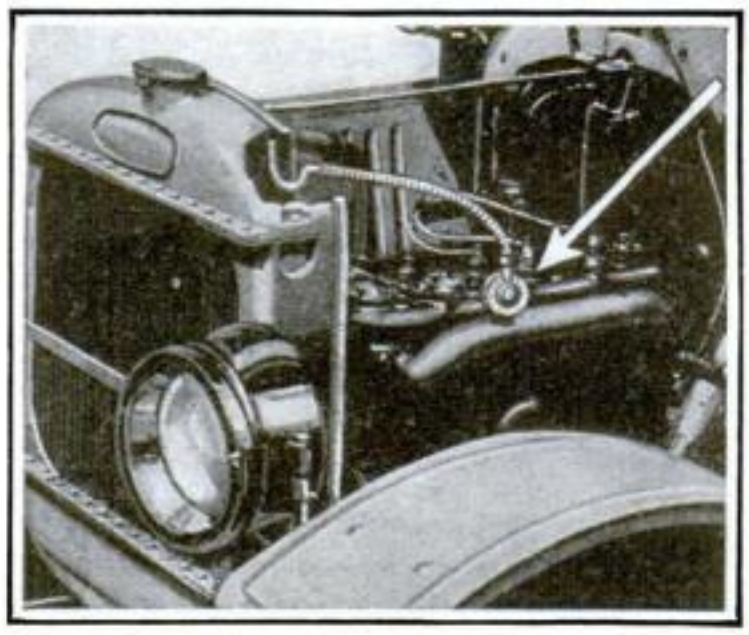
In the compound manifold, shown in the accompanying illustration, the ever-present heat of the exhaust engine gases is used to heat the incoming fuel so that its kerosene element will vaporize more readily and give up its full power. This is accomplished by dividing the manifold into two parts with a metal wall between. The exhaust passes out on one side of the wall and the new fuel comes in on the other. The exhaust heats the dividing wall so that it in turn heats the incoming fuel on its way to the cylinders, where it arrives at a high temperature and in such a highly and completely vaporized state that it gives up its power readily on its explosion. According to some reports, this dual manifold increases mileage from forty-two to fifty-four per cent, and keeps the engine explosion chamber practically free of carbon.



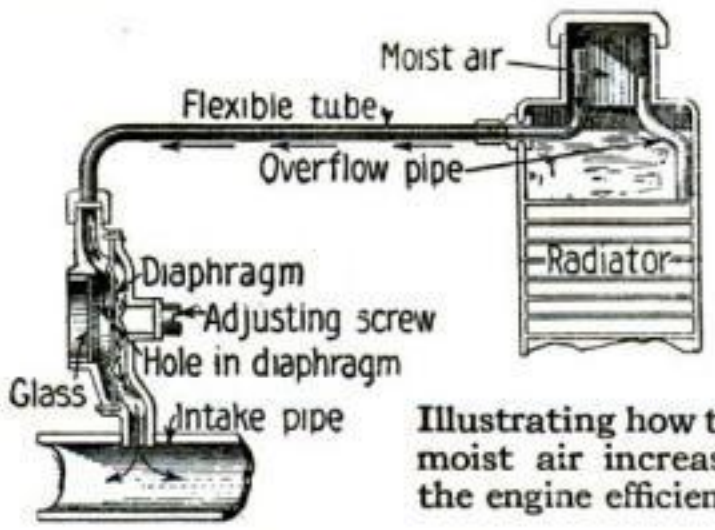
The exhaust engine gases heat the manifold wall and the incoming fuel is vaporized

A New Device Mixes Moist Air with Gasoline Fuel

OPERATING on the same principle as the diaphragm pump, the device illustrated, automatically draws a certain amount of moist air from the radiator of an automobile and delivers it into the gasoline intake manifold. The amount introduced is automatically controlled by the suction of vacuum of the motor, which draws the diaphragm of the device against a cone-shaped adjusting screw that serves to vary the amount passing through a hole in the center of the diaphragm.



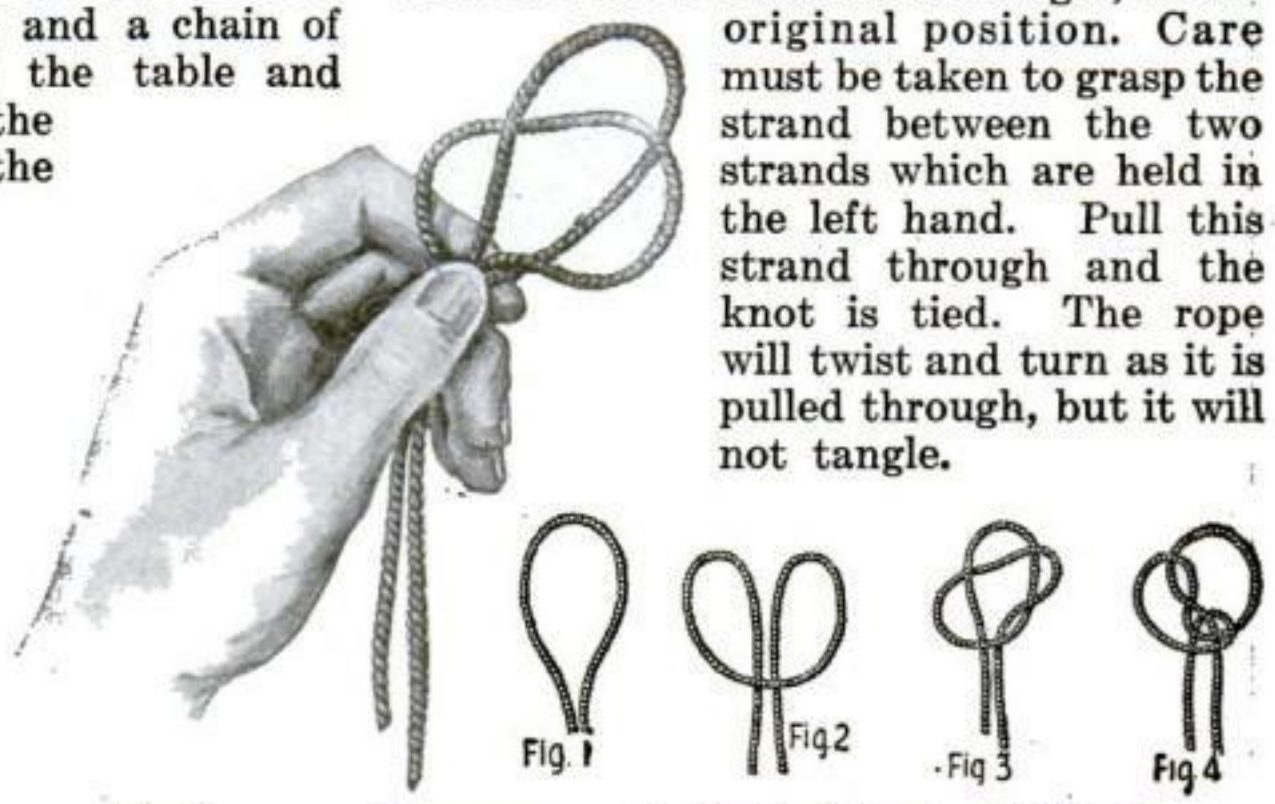
The device draws moist air from the radiator, as shown above



Illustrating how the moist air increases the engine efficiency

How to Tie a Steel Cable in a "Jug-Handle" Knot

IN order to splice a steel cable, it is necessary to make a knot which will not slip or untie. Cable men employ what is known as the "Jug-handle" knot. This is made by grasping the rope in the left hand and forming a loop, as in Fig. 1, with the thumb at the cross. Next bring the loop down so the center of it rests under the thumb, as in Fig. 2. Hold the loop firmly under the left thumb and turn the right half over toward the back and downward, then turn the left loop back and place it behind the strand which has been held under the thumb. The knot is now like Fig. 4. Next, place the finger and thumb of the right hand through the space marked with a cross in Fig. 4 and grasp the strand which was first held between the thumb and forefinger, in the original position. Care must be taken to grasp the strand between the two strands which are held in the left hand. Pull this strand through and the knot is tied. The rope will twist and turn as it is pulled through, but it will not tangle.



The four operations necessary to tie the "Jug-handle" knot

Utilizing Garbage to Lower the Price of Pork

OUT in Omaha City, Omaha, the people are not worrying about the soaring prices of pork. The hotel men of the city have formed themselves into a hog-raising organization, and a chain of restaurants contributes the table and kitchen refuse to feed the hogs, fattening them for the market in record time.

In Hull, Mass., the same idea of utilizing garbage to prepare live stock for the market, is carried out under the city management. Land for pasturing and housing is loaned free and the only expense is the salary of one man who takes care of the herd. The city then controls the price of the pork.

Outdoing the Mine Throwers

Stokes gun used by British proves simple and effective in trench warfare. You drop in the shells. German "Minenwerfers" aren't in it!

A WEAPON with little velocity but which could heave considerable quantities of high explosive into an enemy trench, was badly needed at the beginning of the war. The Germans were the first in the field. Hans worked out little trench mortars he called *minenwerfer*. Soon the British replied with the Stokes gun. This latter is now linked with the famous Lewis machine gun, the Mills and Hale grenades, and the like, as one of the most potent inventions brought about by the war.

Trench mortars and howitzers are merely short-barreled, light-shell pitching guns used for sending shells via the indirect fire route from one trench, over Deadman's land, to another trench. High velocity would defeat its own purpose, just as would direct fire. One would drive the shell entirely too far when the gun was elevated to pitch the shell, the other would merely shoot over the top of the other trenches after the fashion of a rifle bullet. In consequence, a mortar of any sort is elevated to not less than a 45-degree angle. This causes a shell to go skyward and over toward the other fellow like a deceased cat over your alley fence. The method is simple. It is effective none the less.

Photos © Kadel & Herbert

A new gun and various types of shells now used in trenches

The rapidity of the fire is limited only by the speed at which the gun crew can drop shells down the barrel

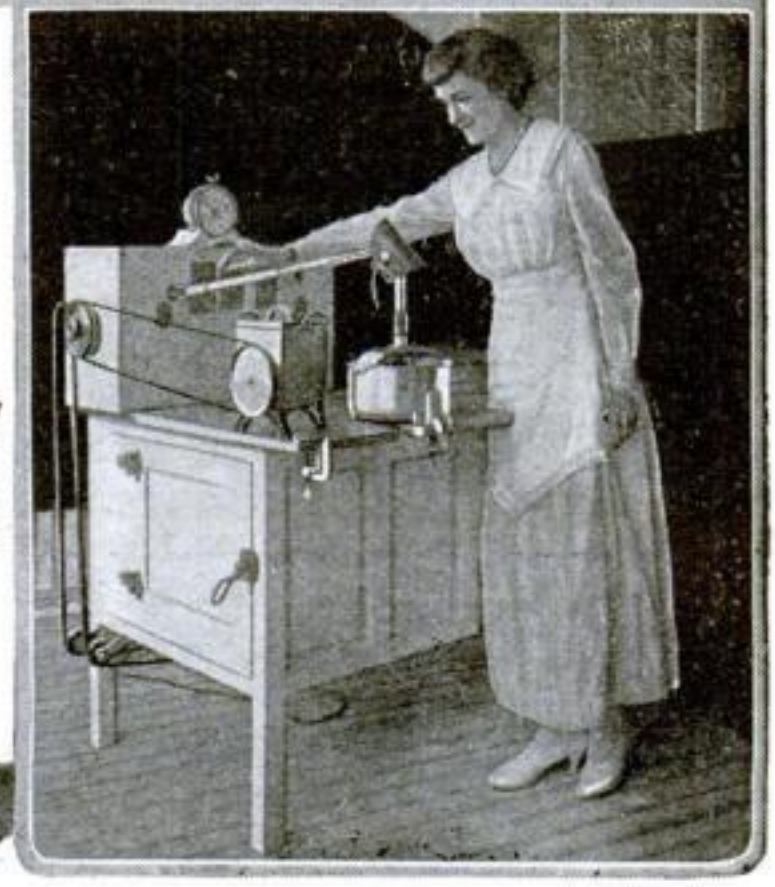
Taking advantage of the fact that a mortar is always elevated at an angle of 45 degrees or more from the horizontal, Wilfred Stokes worked out a shell, consisting of a case containing a large quantity of high explosive, fitted to a base filled with a light charge of propellant powder—also a primer therefor. The bottom of the gun barrel has a projection or stud inside. So when this new shell is dropped down the barrel of the gun from the muzzle, the fall bangs the primer against this stud and sets off the gun.

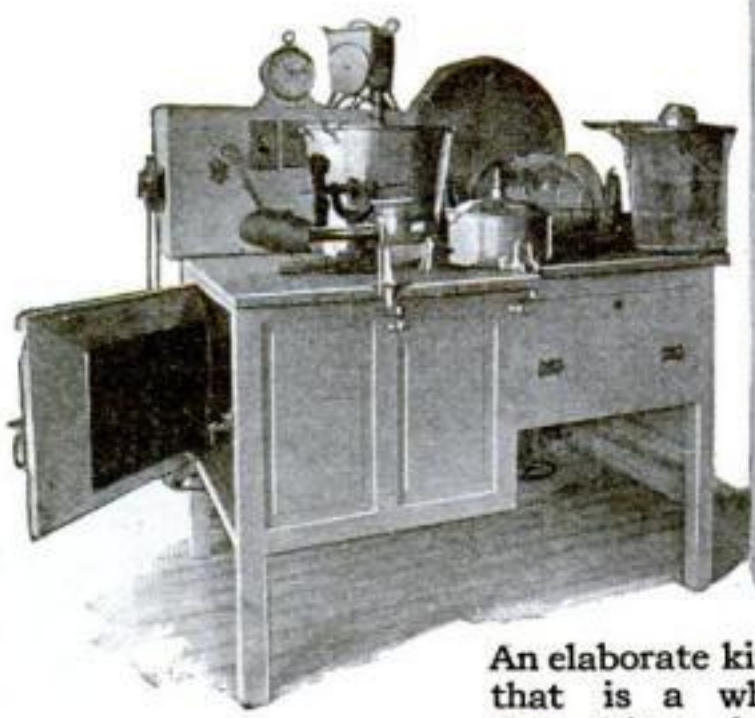
Housekeeping Made Easy

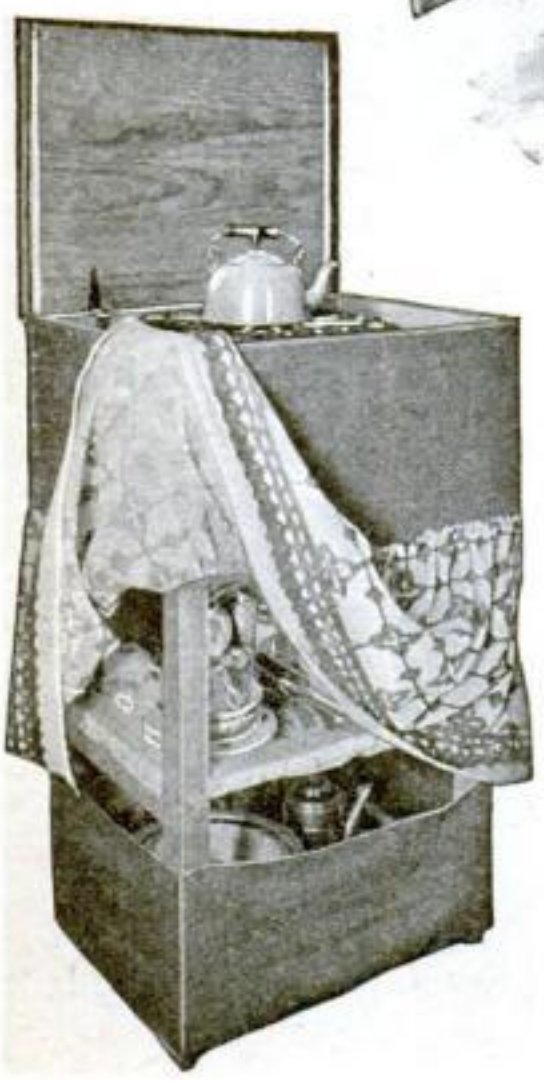
An attractive aquarium hung on a tripod. The glass container is decorated with pond lilies and their leaves

A telephone stand screen of three folds with a flower box in front

A dehydrator for all-the-year-round use in drying surplus fruits and vegetables. It is set over a cook stove



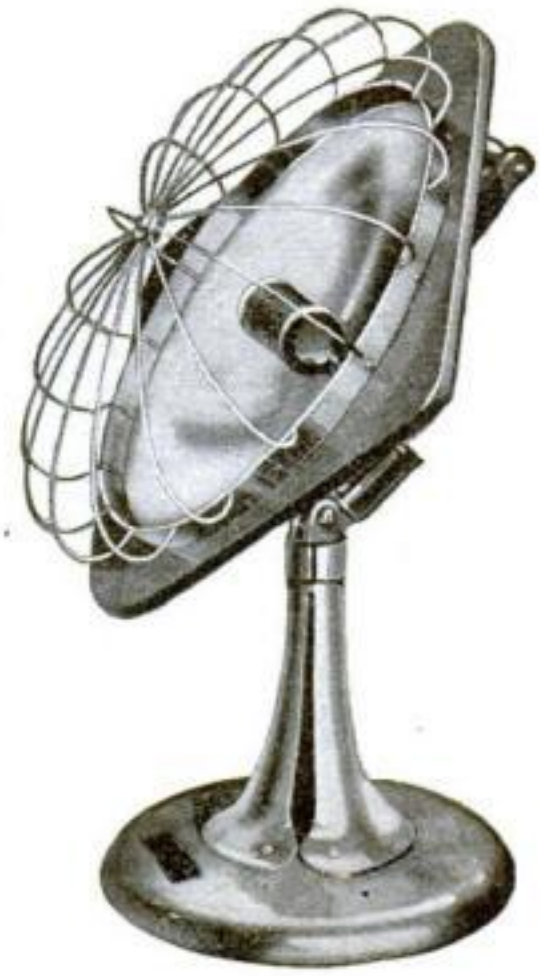




An elaborate kitchen table that is a whole work-shop driven by a motor

Two perforated pans, one inside the other, for baking a pie crust without the usual filling

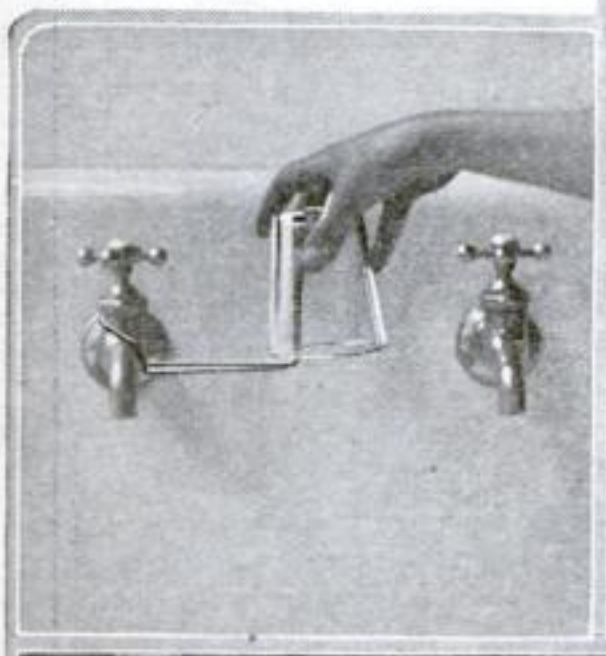
A homemade cabinet especially designed for a boarder. Shelves are provided for utensils and a gas stove plate is placed at the top



An attractive electric heater, like a lamp stand, for use in small rooms, bath and offices where a small amount of heat is required

Housekeeping Made Easy

A wire attachment placed over a faucet handle to hold a drinking glass in an inverted position

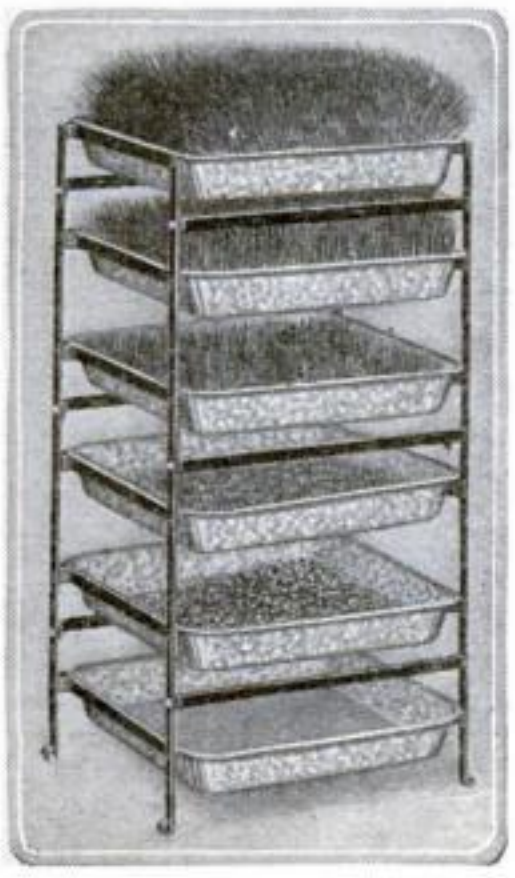


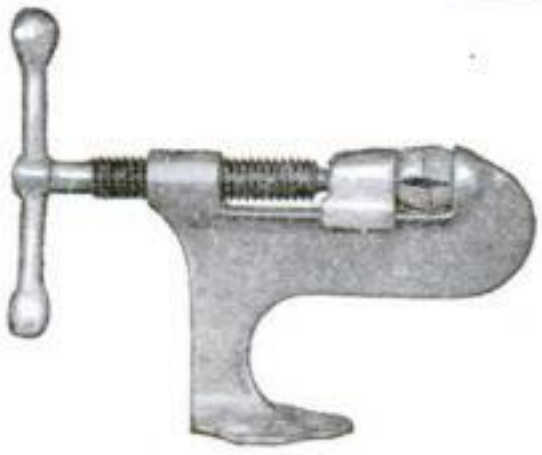
Two positions of a folding tray for use in traveling. When folded up it can be placed in a trunk

Fruit properly canned must be heated while in the container. For handling the jars while hot, this holder shown at the left can be used

An egg cup having a jacket in which hot water may be poured to keep the egg warm for serving

An auxiliary baby seat between the handles of the carriage holds the older cherub when he tires of walking





A handy nut cracker that does not crush the meat. Screw pressure does the trick quickly and neatly

The poultry man will appreciate the new oat sprouter shown at the left. It grows winter grain

French Official Photo

On the top of the hill is a lone bell, serving as a tombstone to mark the grave of the church at Les Boeufs, on the Somme River, in France. For hundreds of miles the country is like this

The Unforgettable Fact—the Murder of France's Churches

THE mountainous mass of debris shown in the picture is all that is left of a once famous church, at Les Boeufs, on the Somme River, in France. Crowning the top of the unrecognizable heap may be seen a bell which, by some miracle of good fortune has been left untouched by the retreating Germans. It is the only thing which remains to tell the story of a splendid structure, erected to appeal to man's better self, only to be sacrificed to the insatiable greed of the war god. One of the most pathetic chapters of this war is the deliberate murder of France's churches. Some of them were erected in the thirteenth century and were not completely finished until nearly four hundred years later.

The Soldier Can Now Lie Down On His Bed of Air

A NEW service bed has been designed by an English manufacturer, which will fit into a small valise when folded. It is made of a fabric strong enough to withstand hard wear. When it is to be made up, an inner casing of rubber is inflated by means of two valves. Should it be torn or punctured, the rubber can be repaired in the same manner as a tire. The bed is twenty-three inches in width, but to accommodate those who find comfort in sleeping with knees slightly raised, the knee-rests have been made seven inches wider on each side. It requires about two minutes to inflate the rubber section. When the bed is not being used, the air is discharged from the rubber section.

The mattress of this new campaign bed for the soldier is a rubber section inflated with air

Pulling Horses Out of the Mud in Rain-Soaked Flanders

WHERE is the muddiest country in all the world? Put this question to the Allied troops and they will tell you as one man that it is in Flanders, the land that was noted for its fertility and beauty before the war, but which is now the scene of desolation and plunder. The illustration shows a Tommy extricating two shell-laden horses mired in the mud. Frequently a bursting shell will cause a number of horses to leave a good road and run for the soggy fields, only to become helpless.

© Press Illus. Serv.

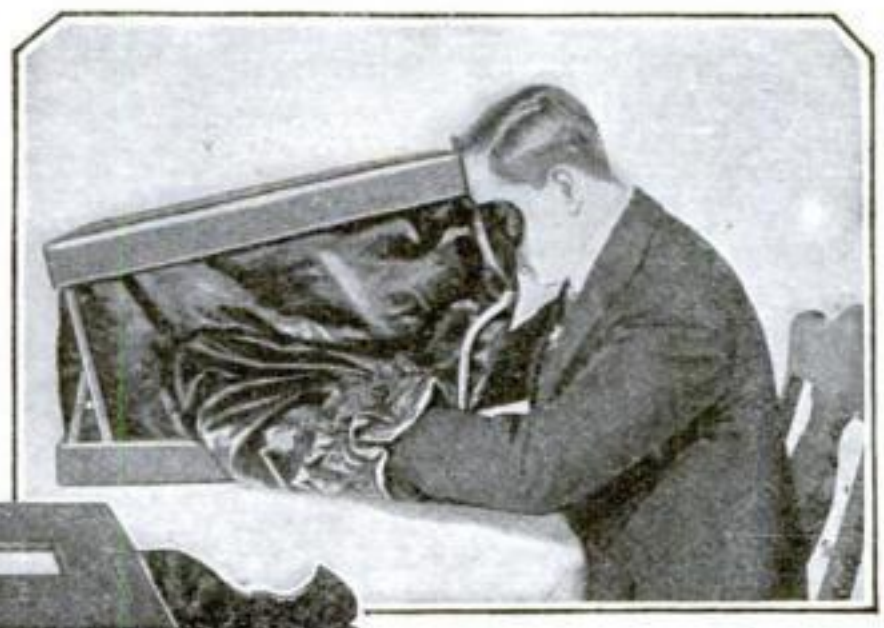
Two horses, laden with the famous French "75's," being pulled out of the knee-deep mud in Flanders

What Makes the Tumbler Pigeon Tumble in Flight?

"THE action of the tumbler is well known to nearly everyone. In its simplest form it is a single backward somersault, made in flight, and from which the bird recovers gracefully. This may be increased to two or three turns in the common tumbler or to a swift succession of four or more in the roller. . . . . That it (the tumbler) has a physiological cause, such as a defective inner ear or brain, there can be no doubt, but the problem is so clouded with what appear to be psychological questions that it will not be easily solved. At any rate the facts remain that the bird does go over, that he does it more freely at times, as when flying with his mate, and that under stress of necessity, when pursued by a hawk or striving to regain his place in the kit, he flies as well as any pigeon. On the other hand, some individuals in the bird family, particularly among the rollers, appear to lose control of themselves entirely, and having started to roll, continue until they strike some object which stops their fall. Such birds, which are known as 'roll-downs,' or 'mad rollers,' never regain the ability to fly safely once they have lost it." (L. S. Crandall, in *Pets*, Henry Holt & Co., New York.) Testing the sense of balance is the main feature of the present examination of prospective flyers.

With This Darkroom, Develop Your Photographs on the Spot

THE modern photographer can develop his pictures wherever he happens to be. The device that makes this possible is a collapsible dark chamber. A large light-proof cover opens at the top through which you place the trays, the plates and chemicals. The chamber is extended by a bracing which can be raised about one foot. Your arms are put through two light-excluding sleeves. Your head is brought up against a hood, and two shutters are opened automatically. You proceed with your work with ease, developing films as well as plates.

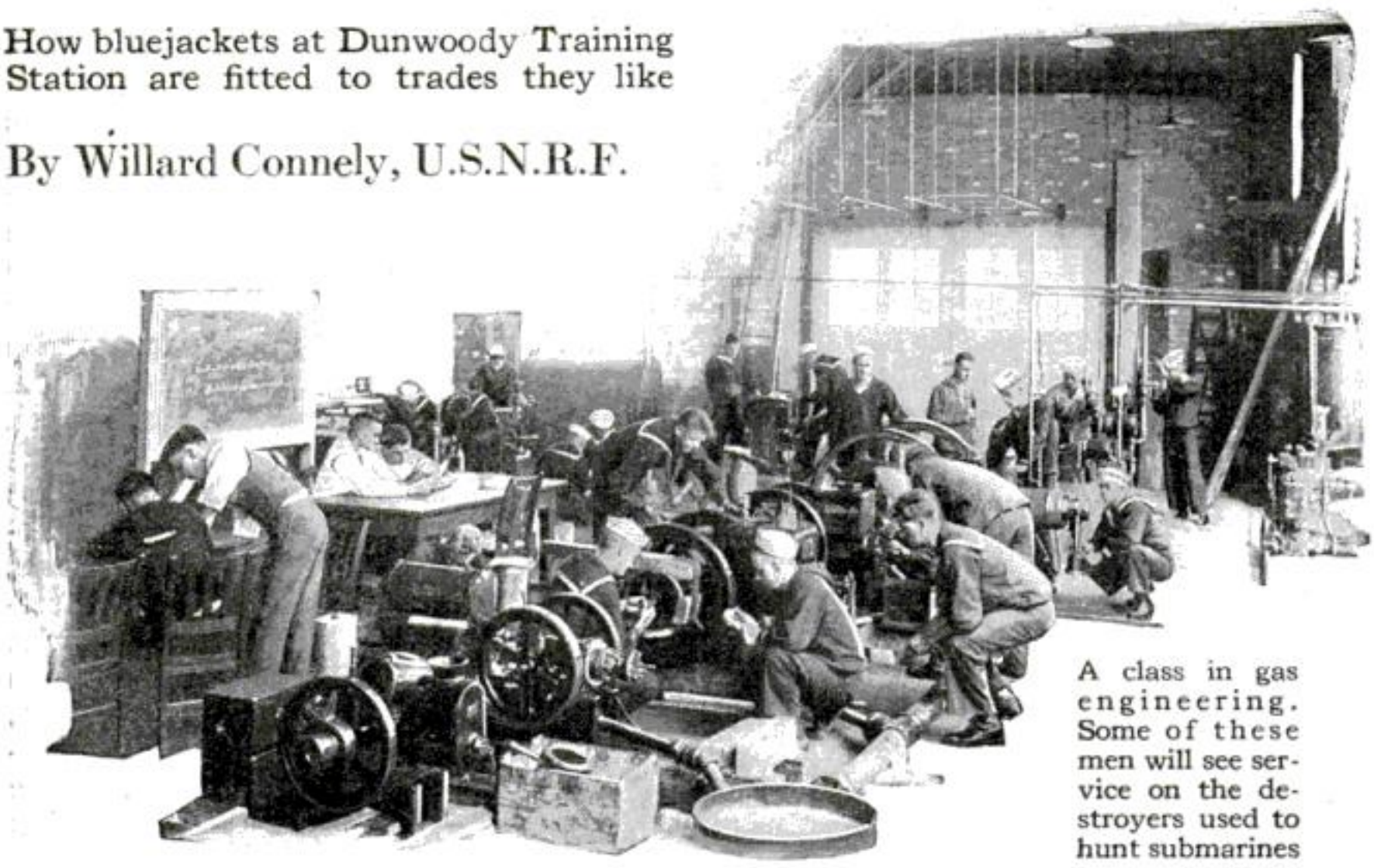


Light penetrates through the ruby glass in the cover of the collapsible chamber

Turning Sailors into Craftsmen

How bluejackets at Dunwoody Training Station are fitted to trades they like

By Willard Connely, U.S.N.R.F.



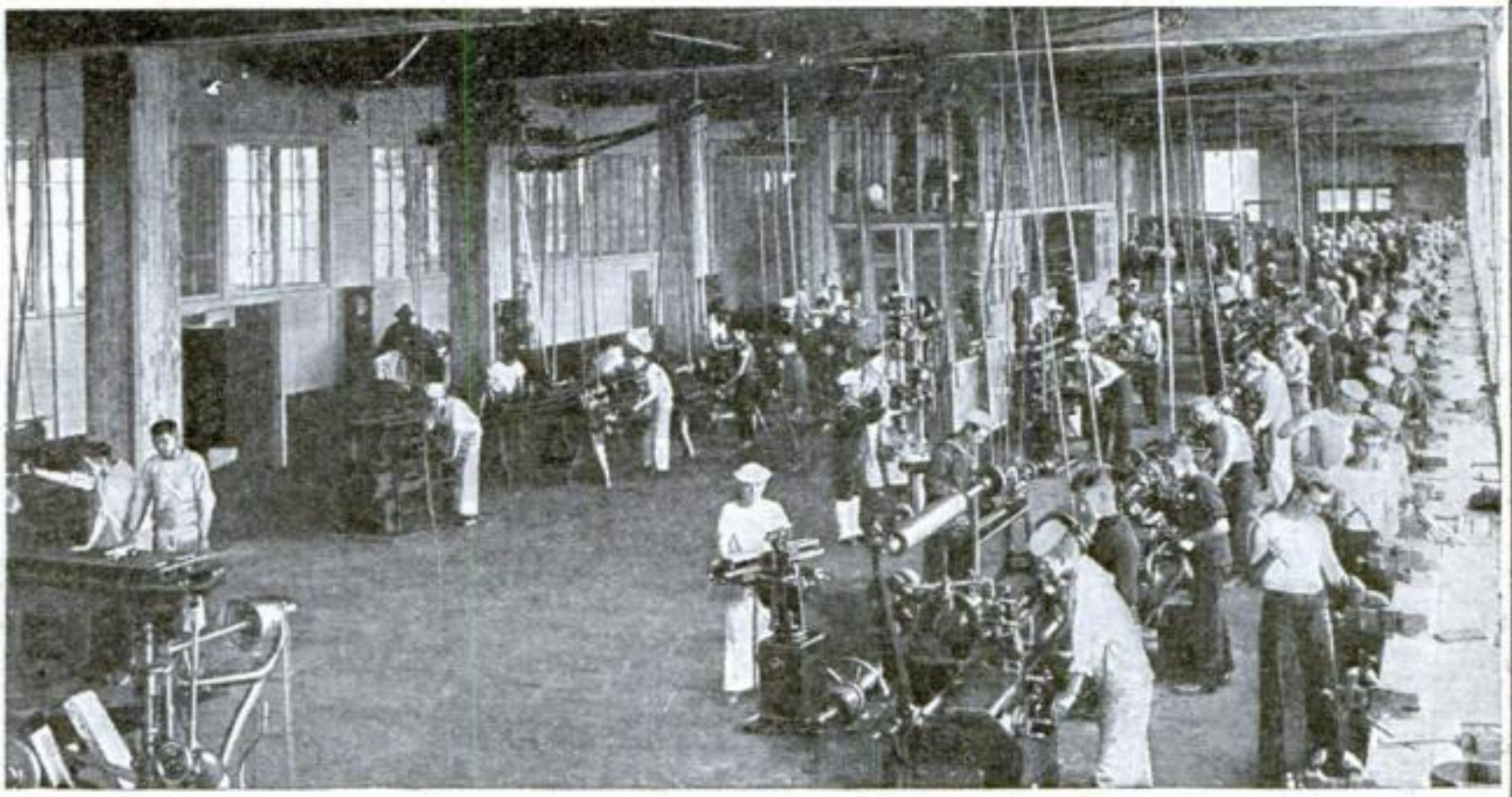
A class in gas engineering. Some of these men will see service on the destroyers used to hunt submarines

THE United States Government is the professor of independence in the University of America. One of his pet classes is the Navy, in which he teaches competence for life to his pupils, the bluejackets. For them he has schools on land as well as on water, from which his approved graduates may re-enter civil life awarded a degree whose counterpart is given at few colleges—the degree of Bachelor of Thoroughness.

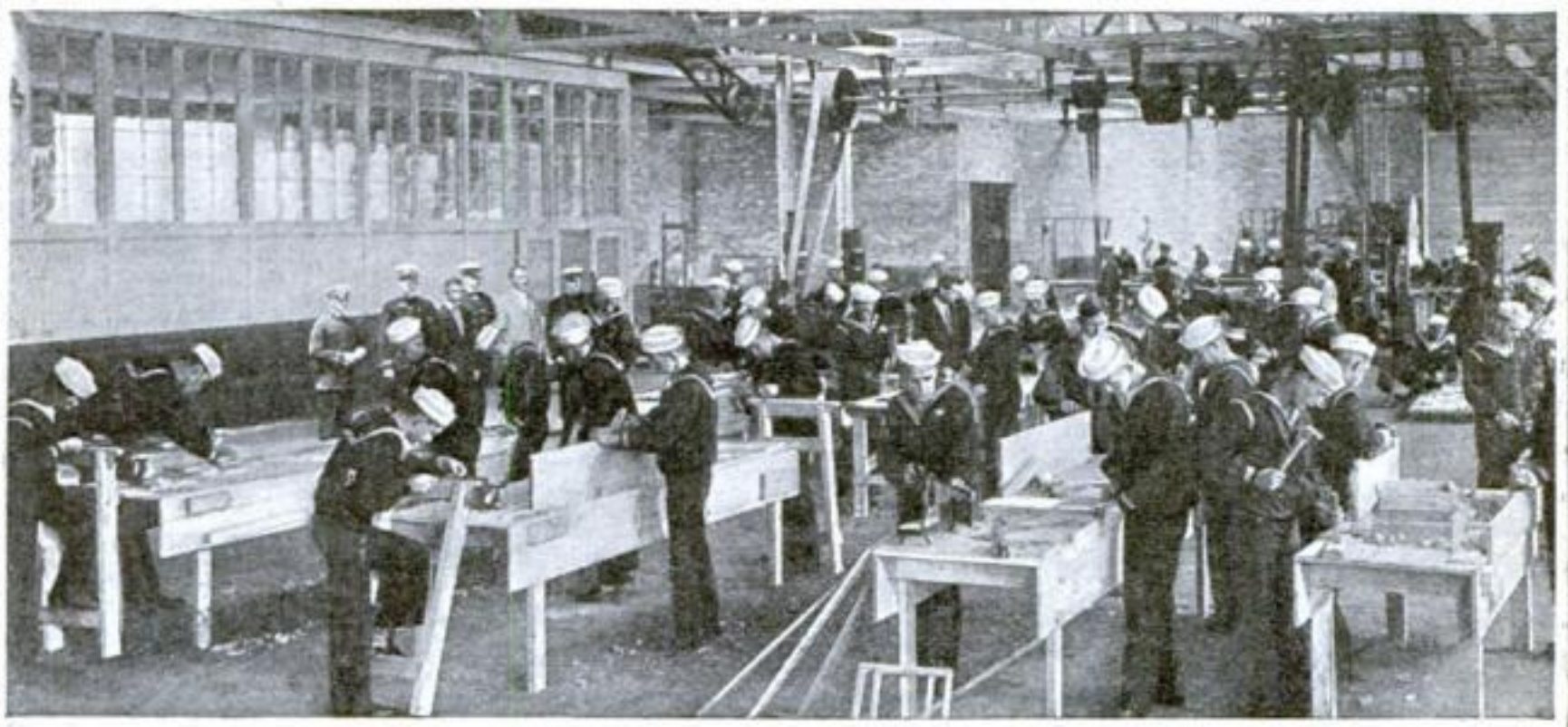
One of these land schools is the Dunwoody Industrial Institute in Minneapolis, now a United States Naval Training Station. There, more than six hundred bluejackets and petty officers are acquiring skill in the crafts which they want to make their life work. The men are not enlisted from one community, any more than the midshipmen at Annapolis are all from Maryland. They arrive in detachments from the various recruiting centers—Detroit, Chicago, Buffalo, Richmond, Pensacola, New Orleans, San Francisco and Seattle.

Nine courses of study are offered the naval apprentices at Dunwoody; and he is an odd youth indeed who never in his life has evinced particular concern about one or more of them. In general, the classes are formed from two sorts of men. Suppose Captain Moffett, Commandant of the Great Lakes Naval Training Station, were to send one hundred radio men to Dunwoody. He first combs his roster for bluejackets who have had previous experience in wireless telegraphy and who desire to continue; second, for men who have long wanted to be operators but who have never had the chance to learn before they joined the Navy. If mental qualifications are satisfactory, the latter men are elected as well, and later graded so as not to be a drag on their more experienced mates. After a four months' course of electrical study and operating practice in the international code, these men are able to receive twenty to thirty words per minute, and can go direct to sea. In electricity, they have laboratory work, and lectures in magnetism, storage batteries, condensers and oscillating currents, spark systems, wave meters and measurements.

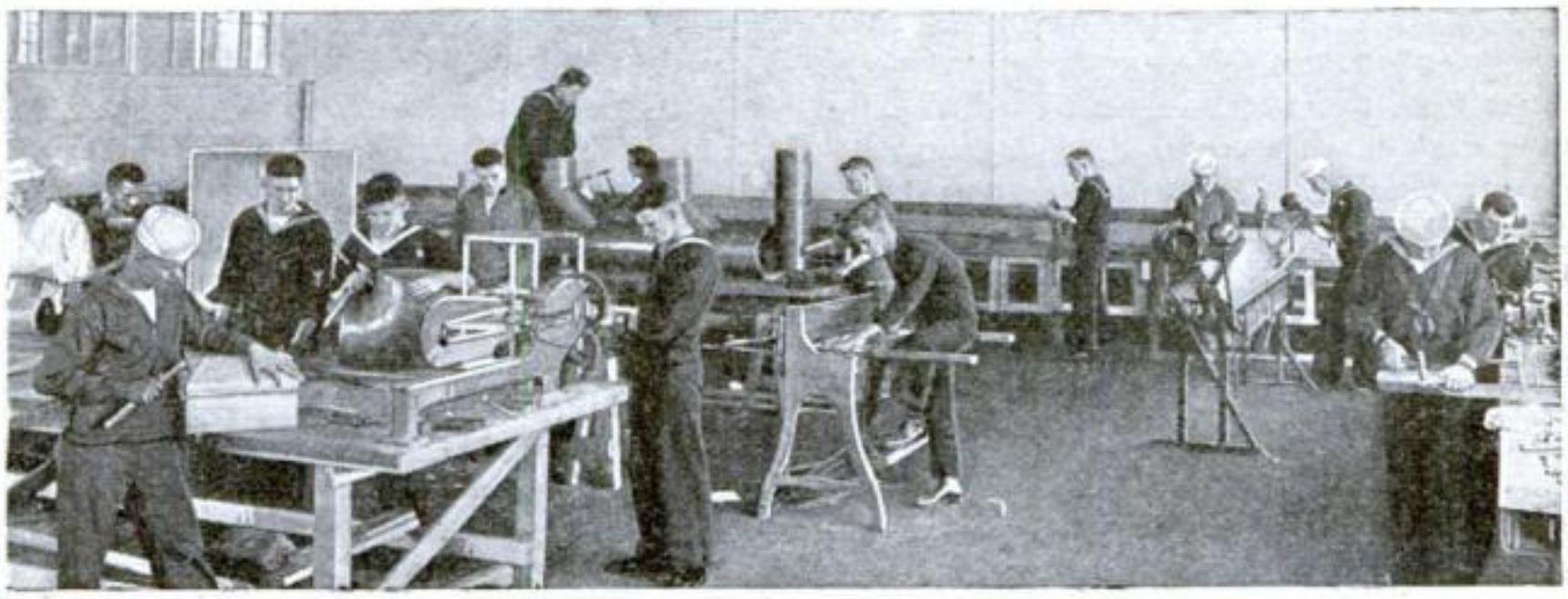
The bluejackets who learn to be ship's bakers probably have as much actual fun out of their work as any. With all the latest scientific mixing and blending apparatus at hand, they leisurely turn out one thousand loaves of bread a day, three hundred loaves going for the general mess



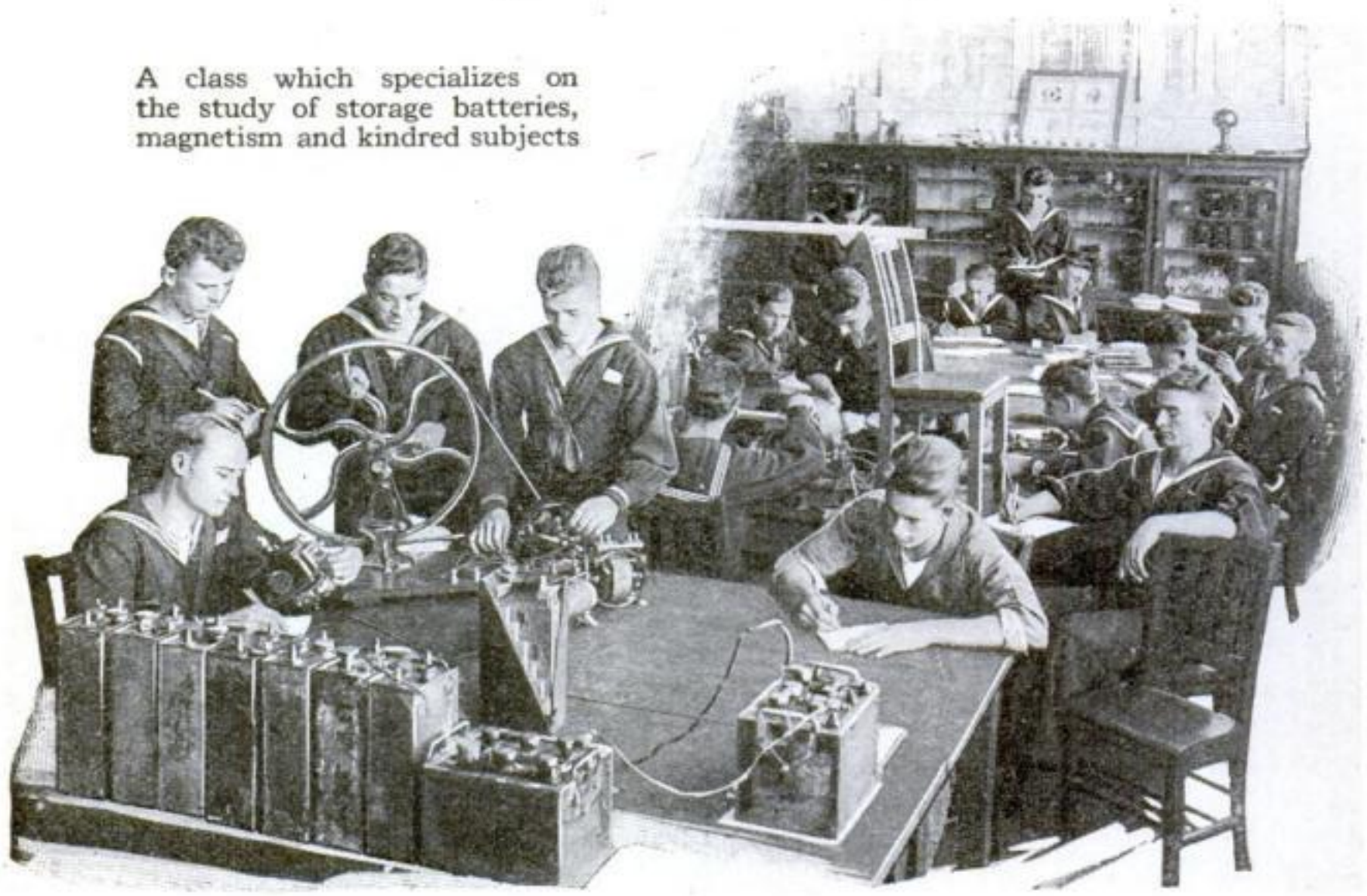
Recruits have progressed to such machines as the grinder and radial drill-press in a short time. Many were formerly employed as expert munition makers at Bethlehem and other cities



Within a month the carpenter's class knows how to build stools, chairs, tables, cabinets and benches. Some of the boys are devising schemes for the construction of dwellings



A class in coppersmithing and sheet-metal work. Pipes, conduits and kitchen utensils are made after blueprints have first been pcepared and passed upon in the drafting room



A class which specializes on the study of storage batteries, magnetism and kindred subjects

and the remainder being sold to a local baker at cost. On demand, they supply a hundred apple pies or fifty chocolate cakes in the course of a morning.

"Will you run a bakery of your own after the war?" I asked one of them.

"Not much. This is no life for me," was his swift answer.

"Then why are you taking the course?"

"I want the chemistry that comes with it. I work in the chemical laboratory after hours. I'm going into the drug business after I've served my next enlistment."

Many of the apprentices are as resourceful as that, with their eyes constantly on the future. In what is called the "related work," as chemistry to baking, they have the chance to specialize as they desire. The man who wants to be a druggist made such a good record as a baker that he was advanced to an assistant instructorship.

In fact, out of every fifteen men at Dunwoody, one has been found proficient enough to earn the post of assistant instructor. On Saturday mornings these men are taken aside in special classes by the chief instructors, who give them work in theory and applied problems.

The men in the gas-engine class are learning to be motorboat pilots. They will operate the boats used by the naval officers in getting from one ship to another in a fleet, or in going ashore from anchorage out in the harbor.

The coppersmiths are making pipes and conduits, boxes and kitchen utensils. In all their work they first make blueprints in the drafting room. The assistant instructor here is a bluejacket from Seattle, who has been in the coppersmith business for himself. When war was declared, he sold out his shop at a sacrifice in order to do his bit in the Navy.

Not the least important of the classes are the cooks. To prepare the food for six hundred hard-working bluejackets three times a day would seem enough to do, but these fifty embryonic chefs have scientific instruction in the classroom too. They are taught how to cut sides of meat, to know the comparative food values of vegetables and breadstuffs, and how to compose a balanced menu.

So it is not difficult to understand why the naval training course worked out by Ensign Colby Dodge, U.S.N., Commanding Officer at Dunwoody, and by Dr. Charles Prosser, Director of the Institute, means something more to the bluejacket, than scrubbing the deck or polishing the brass. It is the free gateway to a self chosen and lucrative career.

Seeing A Trillion Miles

You do it every clear night that you turn your eyes skyward and watch the stars twinkle in the heavens

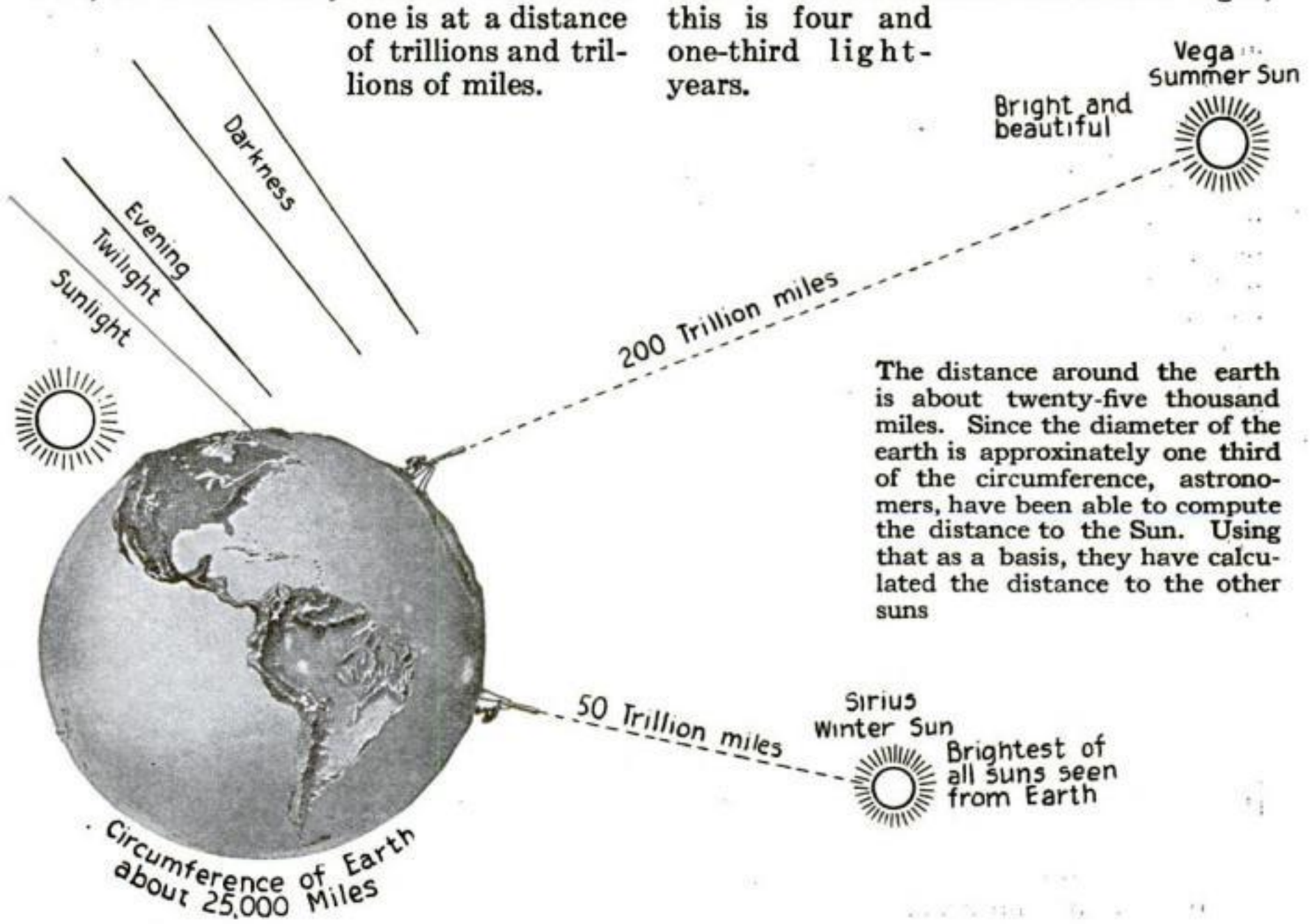
TO see a trillion miles seems superhuman, but it is done nevertheless. In one way, we can see many trillions of miles, but, as we should expect, not very clearly. We can see the Sun, and he is more than ninety millions of miles distant. Thus, when we gaze at him, we are seeing many millions of miles.

Now, most of the stars are suns. They shine and give out heat exactly as the Sun does, only many of them are much brighter and hotter than he. The reason why they do not look as large and as brilliant, is because they are so very, very far away—trillions of miles, instead of millions. After astronomers had calculated the distance to the Sun, they were able to estimate the distance to the other suns. Obviously, these distances to the stars are not accurate to a mile or indeed to many, many miles. However, it is absolutely certain that each one is at a distance of trillions and trillions of miles.

A few of the stars are not a trillion of miles away. These comparatively nearer stars are known as "planets," and all of us have heard about or seen Venus, Jupiter, Mars, or Saturn. In fact, there are quite a number of planets, big and little, and these vary in distances from millions to between two and three billions of miles. These planets shine with the light from our Sun, reflecting that light to us. We see them with our eyes or our eyes assisted by a telescope. We are able, therefore, to see billions of miles.

But, still more wonderful, we can see trillions of miles! According to astronomical science today, all of the suns of night are trillions of miles distant.

Indeed, so far off are they that astronomers usually speak of their remoteness in terms of "light-years,"—that is, the time it takes the light from these stars to reach us. In the case of the nearest known sun of night, this is four and one-third light-years.



The distance around the earth is about twenty-five thousand miles. Since the diameter of the earth is approxinately one third of the circumference, astronomers, have been able to compute the distance to the Sun. Using that as a basis, they have calculated the distance to the other suns

The Mechanical Owl of the French Army

A night-roaming airplane with rockets and searchlights to throw light on a Zeppelin's intentions

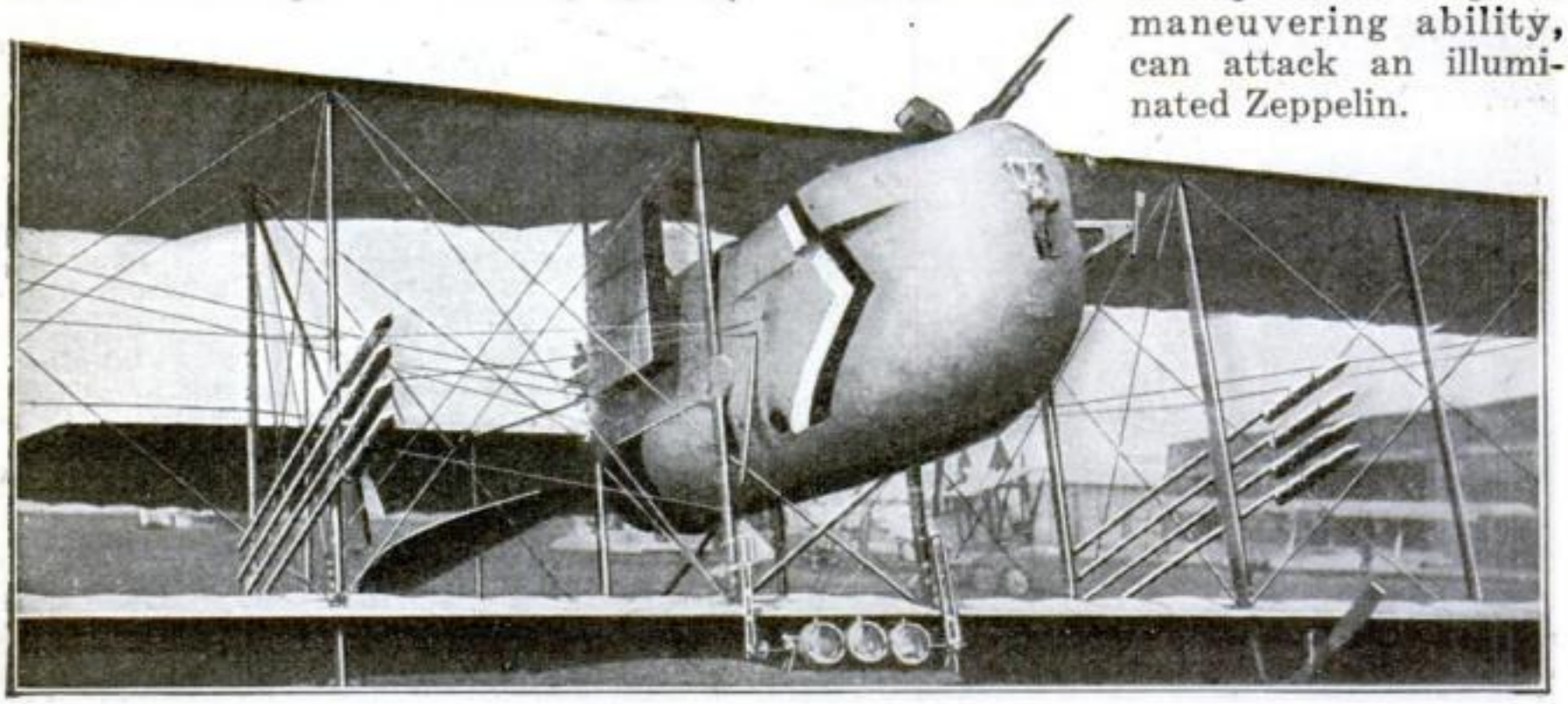
NIGHT flying has become a military necessity for reconnoitering and bombing as well as for attacking Zeppelins, which always bomb at night. Extraordinary demands are made on the skill of the pilot. A landing at night can be safely made only if the ground is illuminated or guiding beacons are employed. Were it not for the fact that the average night sky is not pitch black and is even slightly luminous, night flying would be even more dangerous than it is. Yet on those nights when overhanging clouds cut off even this faint luminosity, when everything is wrapped in inky blackness, it may be necessary to send an aviator aloft.

Recently the French had to convert the night plane into something like an owl, so that it can fly even on pitch dark nights. Like an owl, the machine, with which they have experimented, is very slow—an old-fashioned Farman "pusher" which would fall a ready prey to a fast enemy machine in daylight. But how does it find its way? By illuminating devices, of course. They may not be heavy because the machine cannot carry much additional weight. There are three luminous eyes in the form of searchlights mounted on the lower plane, as our photograph shows. As the owl swoops down on its prey, they flare up and enable the pilot to single out the target.

But sometimes the searchlights are inadequate. Greater efficiency is often demanded. And so we find that the machine carries as well eight illuminating rockets, four to the side. They are mounted nearly horizontally between the wings and are no doubt discharged by electrical devices. The mere pushing of an electric button is enough. Rushing out with a hiss, far out in front of the machine, each emits a dazzling flare, which, suspended from a small parachute, lights up a large area through which a machine may pass. The flare lasts long enough to enable the aviator to make an emergency landing if need be; for the lights of an airdrome are difficult to pick up.

By means of rockets, it has become possible to sight a Zeppelin in an inky sky. At night a Zeppelin is detected only by its propellers. It is practically invisible. But, if the rockets be aimed in the direction of the betraying noise, by swinging the entire machine, there seems no reason why it should not throw real light on the Zeppelin's intentions.

These owl machines seem especially intended to mother small *avions de chasse*, which, because of their speed, climbing and maneuvering ability, can attack an illuminated Zeppelin.

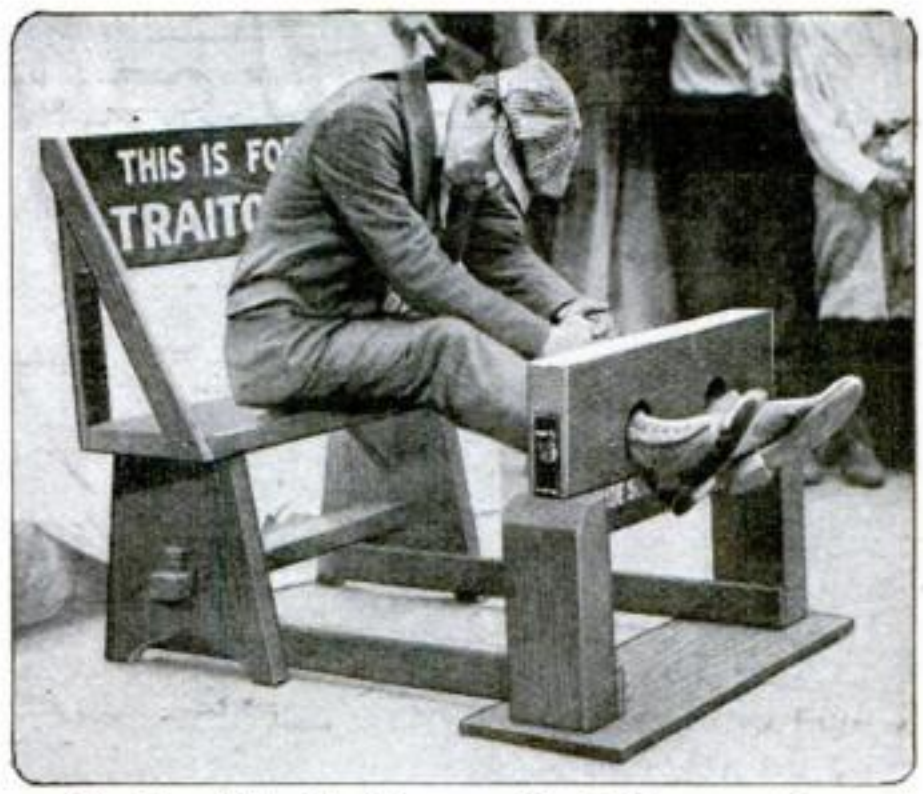


© Int. Film Serv.

The rockets on this night machine are electrically discharged. They are for use when darkness confuses the aviator. Each rocket carries a flare at the end of a parachute

Who Would Think That the Little Mole Is a Gormandizer?

THE little mole has recently been recommended for membership in the society of big eaters. It is so very voracious, even in captivity, that it will sometimes eat more than its own weight of earthworms in twenty-four hours. One little glutton, weighing four ounces, devoured seven and one-half pounds of worms in one month. When the diet changed to raw beef, mutton, chicken heads and rabbit liver, its appetite was unchanged. Cheese, when mixed with either worms or beef, was the most toothsome bit of all.



Cincinnati's effective warning to her populace: Be loyal or to the stock you will go

Wait for the Fire Net—It Will Come Up to Meet You

A PORTABLE fire net which may be raised to meet those who fall, or find it necessary to jump from windows of burning buildings to save their lives, has been invented by Allen Warwick Smith, of New York. It is the inventor's object to bring the net nearer, or adjacent to the upper stories of buildings, to instil confidence in those who fear to jump, and also to prevent the person falling from gaining sufficiently great momentum to crash through the net.

Should it be necessary to keep the net some distance from the burning structure to avoid contact with flames issuing from immediately below, an additional net or platform is fastened to the window upon which those who desire to reach the main net may walk or roll. The upright supports are mounted on combination castors, so that the net may be rolled along the sidewalk or held stationary. All parts of the net are detachable and can be folded for transportation.

In a fire, the portable net is rolled up close to the imperiled building so that the first platform is within easy jumping distance

Reviving Ye Olden Tyme Stock in Cincinnati

A COMMITTEE of patriotic citizens of Cincinnati, who desired to impress upon the minds of certain people that the old time method of punishment would be meted out to those found guilty of unpatriotic utterances or of conduct unbecoming an American citizen, placed this straight backed seat and stock in Government Square. A few hours' imprisonment in the stock would be ample punishment for any offender, said those who were responsible for the demonstration.

Plainly inscribed on the stock are the words, "This Is For Traitors." The young man in the picture consented to pose for the photograph to illustrate how uncomfortable a real offender would appear in the stock. He is innocent of any wrongdoing himself. His legs are held securely in the wooden block, which is fastened to the framework with lock and key. No one has yet occupied the stock—and we hope it will remain untenanted.

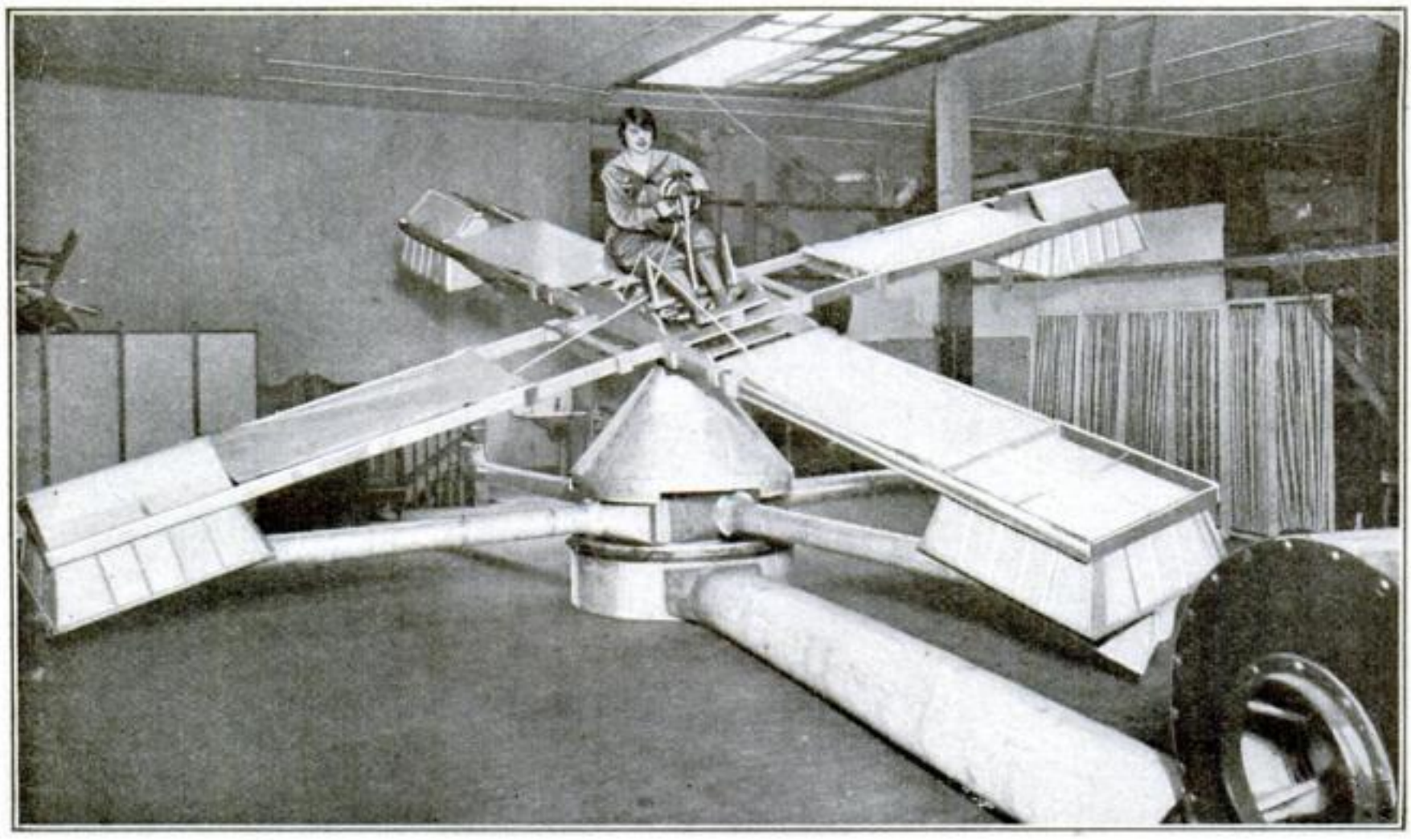
Learning to Fly on Jets of Air

Do you remember the ball that dances in a jet of water in every shooting gallery? Here's an instruction machine built on that principle

IT'S expensive to train airmen. On the average, students break from one to two airplanes each before they have mastered the rudiments of the art and know how to fly. Private aviation schools charge heavily for breakage. Uncle Sam has to pay the bill himself. In any event much money is wasted. The training of 5,000 aviators means the destruction of 6,000 machines at the very least, and each machine costs about $7,000.

Now airmen may learn at least the fundamentals of flying on a machine like that here shown. It's on the ground, for which reason students can't break much. Yet they go through practically all the motions of controlling a machine in a treacherous, gusty wind.

The machine in the foreground is a fan. Through the connecting tube it blows a strong current of air to the conical pedestal of the make-believe wings. Through the conical device the air is delivered at four points against the underside of the cross-shaped wings above. It is the fledgling aviator's job to sit up on top of this cross-shaped structure and to keep it balanced against those jets. The pupil-operator maintains his balance with regular airplane controls. You know that a ball held up by a jet of air or water dances constantly, even though it stays in the jet. Imagine then what a task a man has when the structure that he is to balance is supported at four different corners only by flickering



This air lady is learning all about flying—without leaving the ground. It is her job to keep the machine balanced against four air currents coming from the pipes beneath

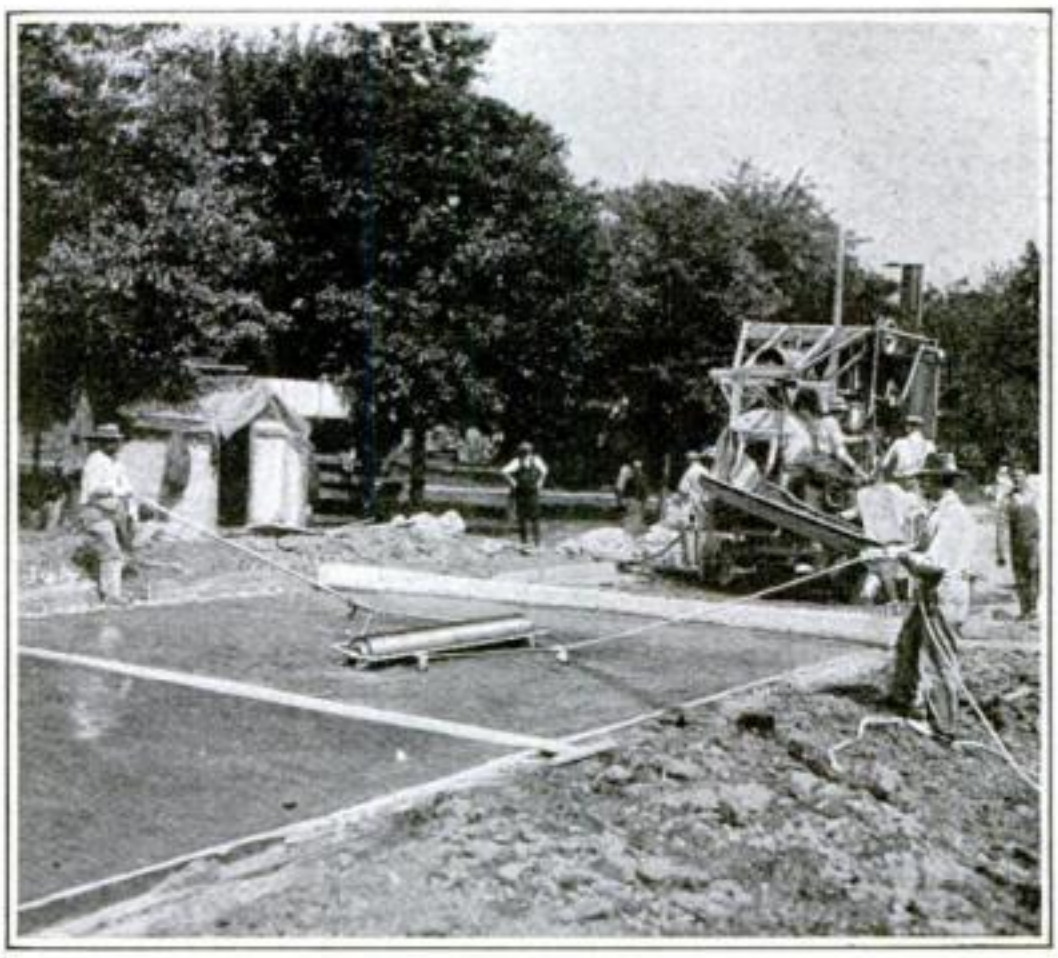
jets! His controls open or close the "boxes" above the jets just enough to keep him balanced. Foot levers manipulate a "vertical rudder" as in an airplane. This vertical rudder is visible just beneath the nearest box. Tilting it to one side or another enables the airman to keep his machine in the path of the jets.

Attempts at devising practical ground training machines for flyers have been made before. Long ago the French constructed a machine in which the candidate was placed high up on a pivot. It was the candidate's task to balance the machine by manipulating a control pulled on sliding weights. These moved out laterally in four directions along arms somewhat smaller than those illustrated. This machine was interesting in principle, but it could not simulate actual flying conditions accurately, since weights will not move with the same uncertainty as air currents. The new machine probably will be more satisfactory.

The Largest Check in the World Was Easy to Cash

THE biggest check in the world is not the one made out recently by J. P. Morgan for some hundred millions of dollars, but one made out for a mere five hundred and seventy-five dollars on paper twenty-two inches long and ten inches wide. The check was drawn by the Otterbein Men's Bible Class of the Grace United Brethren Church of Carlisle, Pa., in favor of the new church building fund. The check is printed in gold and contains a photograph, in the left hand corner, of the pastor of the church.

This, the largest check (in inches) ever made out, was given toward a church building fund. It measures twenty-two inches in length



Excess water makes concrete easy to handle, but impairs its strength. So after the road is laid, this roller is used to press the concrete "dry"

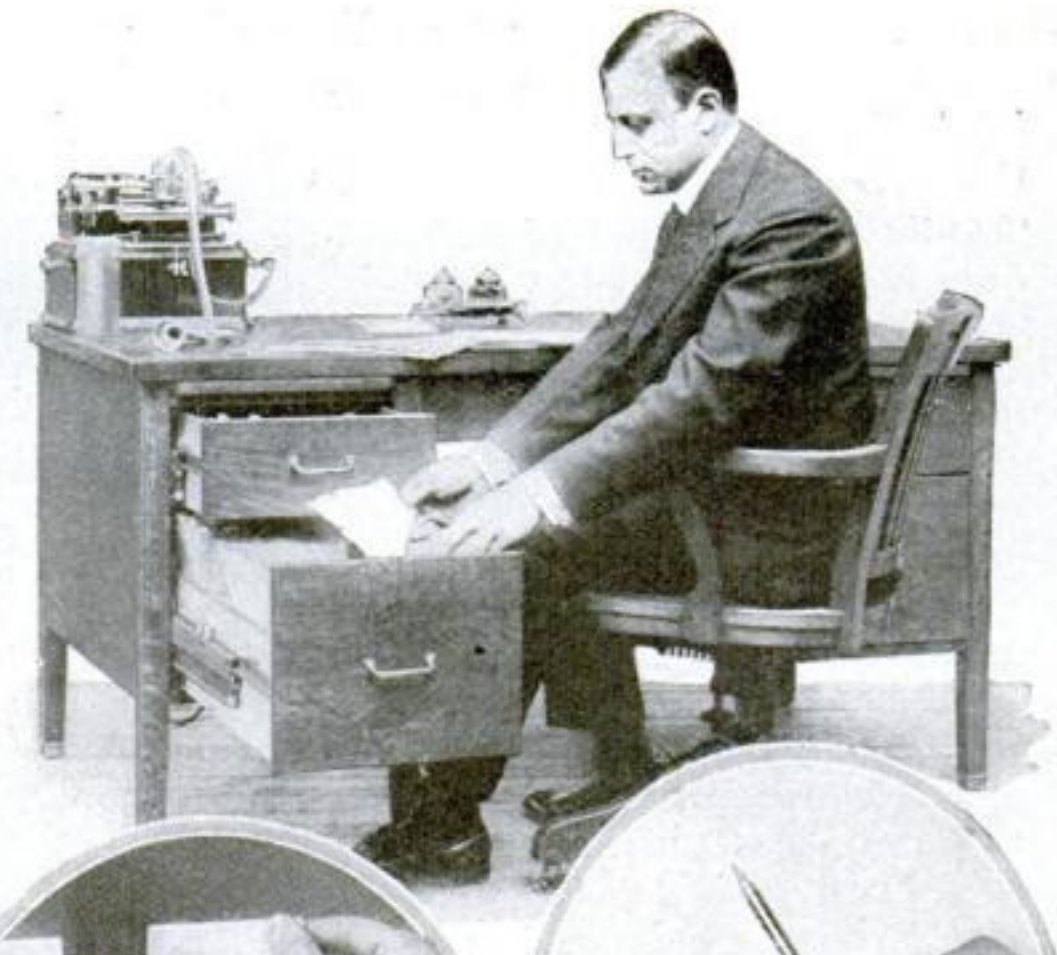
Squeezing the Excess Water Out of Newly Laid Concrete Roads

WERE it not for Captain J. J. Gaillard, City Engineer of Macon, Georgia, excess water would still be regarded as an unavoidable evil in building concrete roads. He has originated a finishing treatment for the concrete, which squeezes out a large amount of the water after the road has been laid.

After the concrete has been roughly finished, a wide, heavy roller is drawn across the road. The weight of this roller removes the uneven spots in the road, and at the same time presses out the water that has lodged in the minute spaces in the sand and gravel of the concrete.

When this operation is repeated many times, there is little water left. Especially is this so in the top surfaces of the road bed. The result is that where the wear on the road is the greatest, the concrete will set rigid.

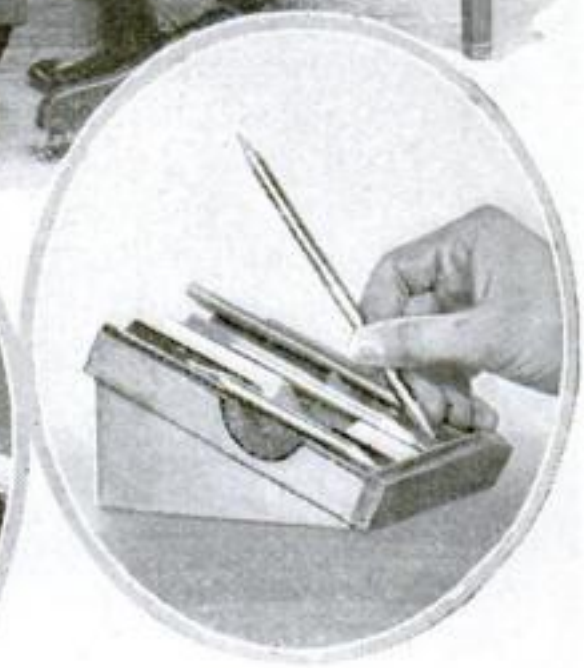
Some New Devices for Comfort and Convenience. These Appliances Help the Wide Awake Office Man to Attain Efficiency



The desk at the right outwardly resembles the ordinary office desk. But it has handy card and letter files fitted into every drawer

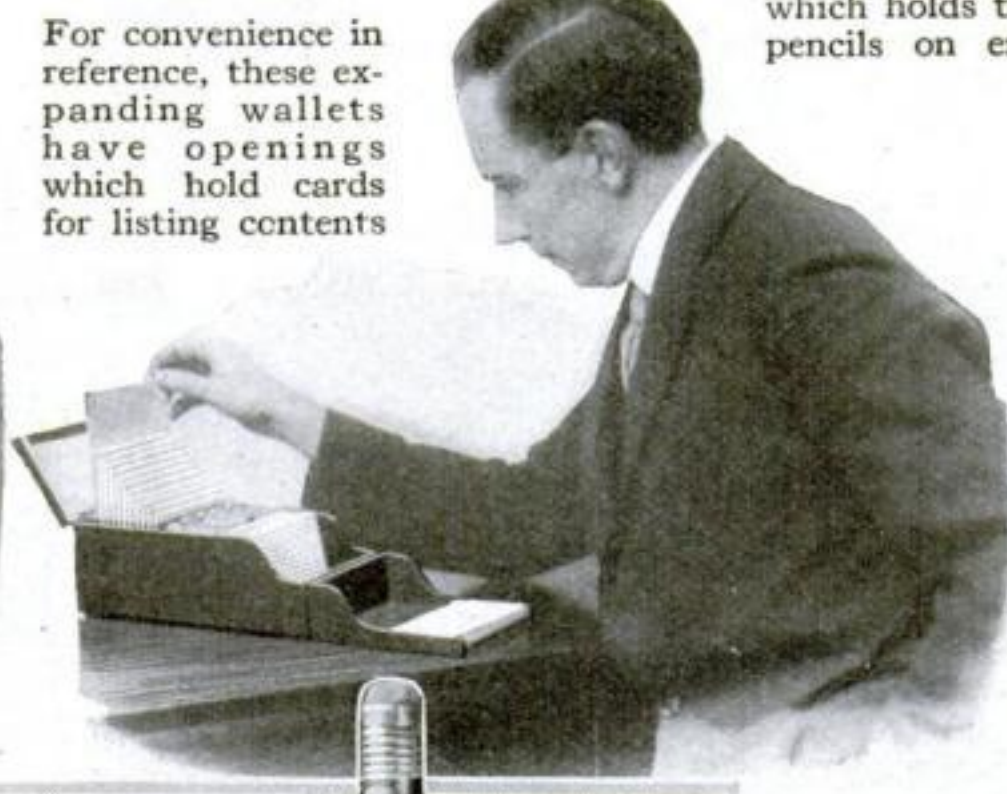
Above: A metal device for rapidly creasing papers. It fits on the thumb

For convenience in reference, these expanding wallets have openings which hold cards for listing contents



A pencil rack invented by Frank Gilbreth, which holds the pencils on end

A fireproof steel cabinet inclosing a mechanical account record. It shows the net profits from every employee and gives an inventory of your business



A small press designed for the office. It tabulates paper for scratch pads

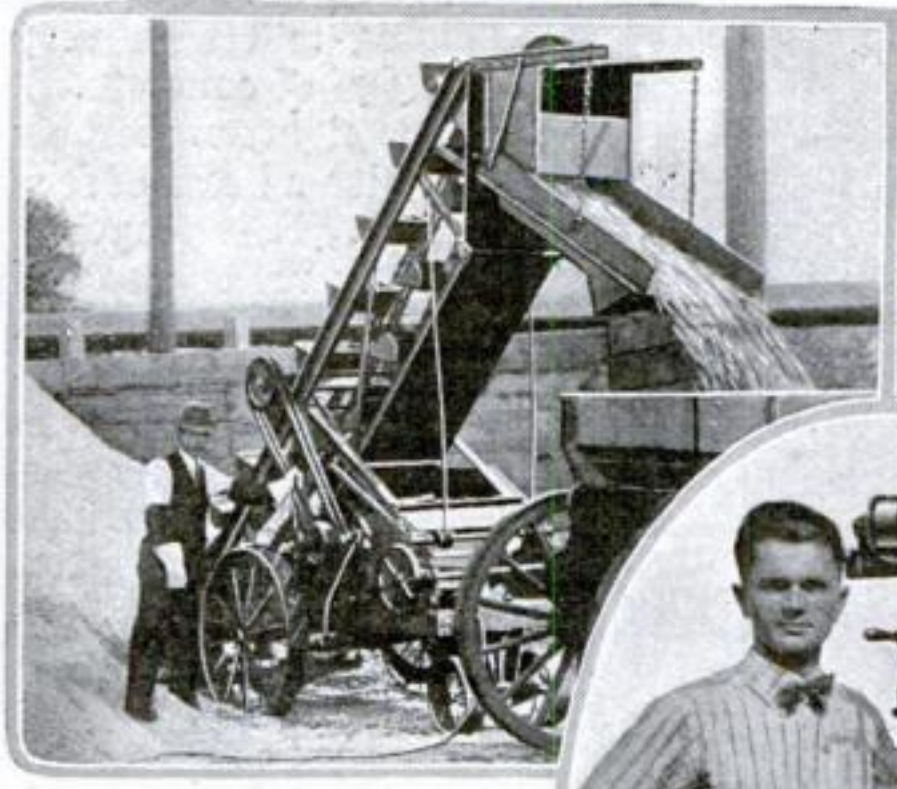
A lead pencil having calendar attached

A desk reminder which is similar to a card file, set in step form for more easy reading. An additional supply of blank cards is in the holder

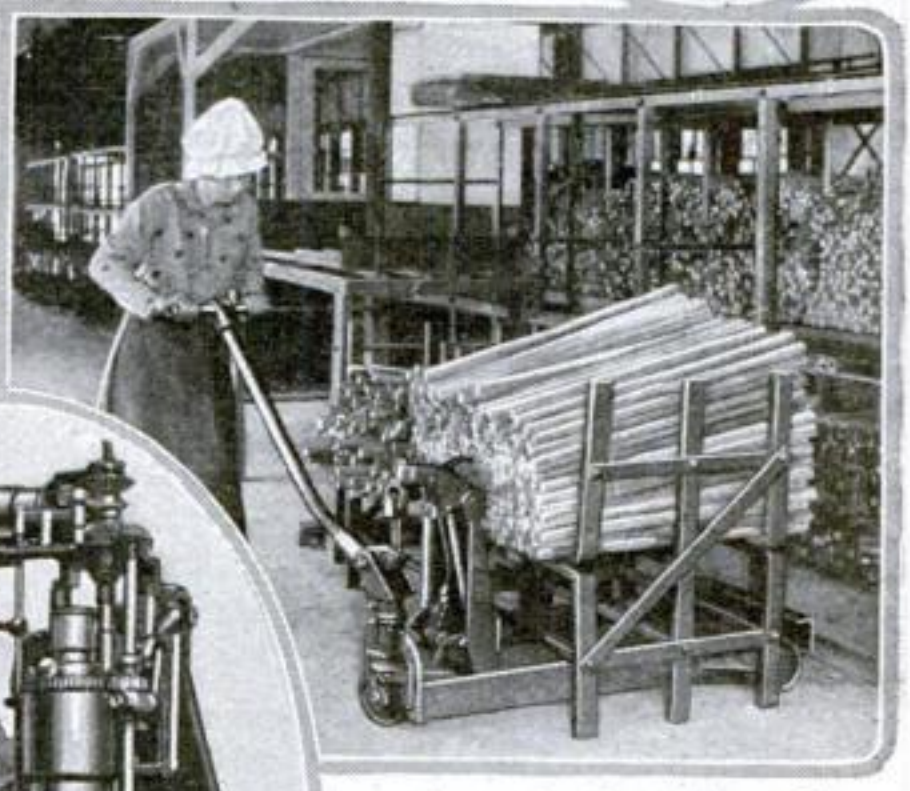
Clever Labor Saving and Safety Devices for the Mechanic Who Is Up-to-the-Minute in His Craft

At left is shown a small saw set with a grip like a pistol

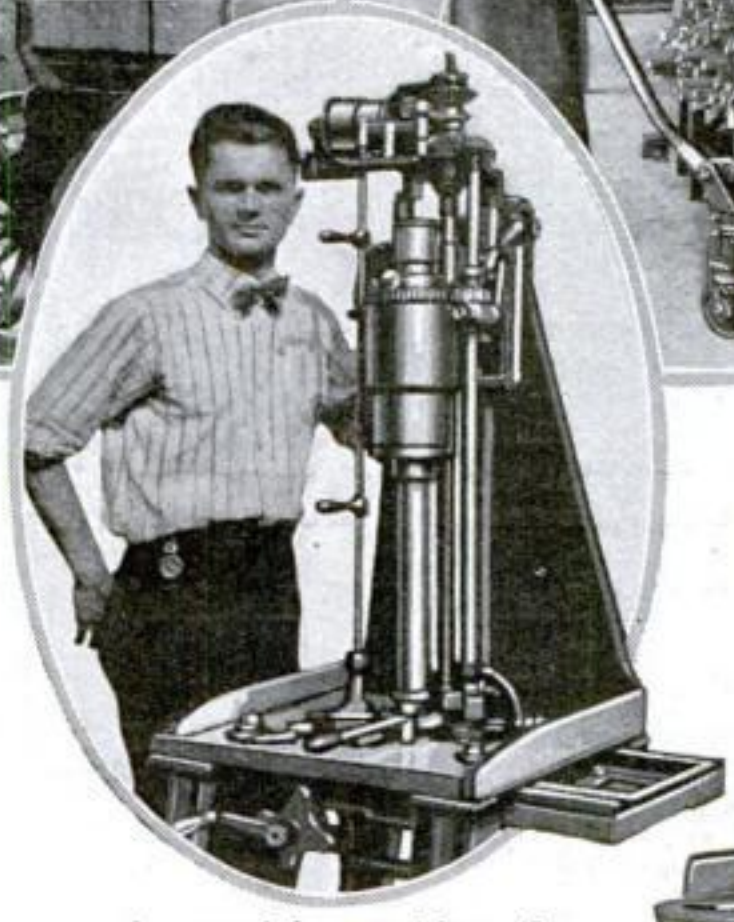
At right: A gage for finding the lead of a thread



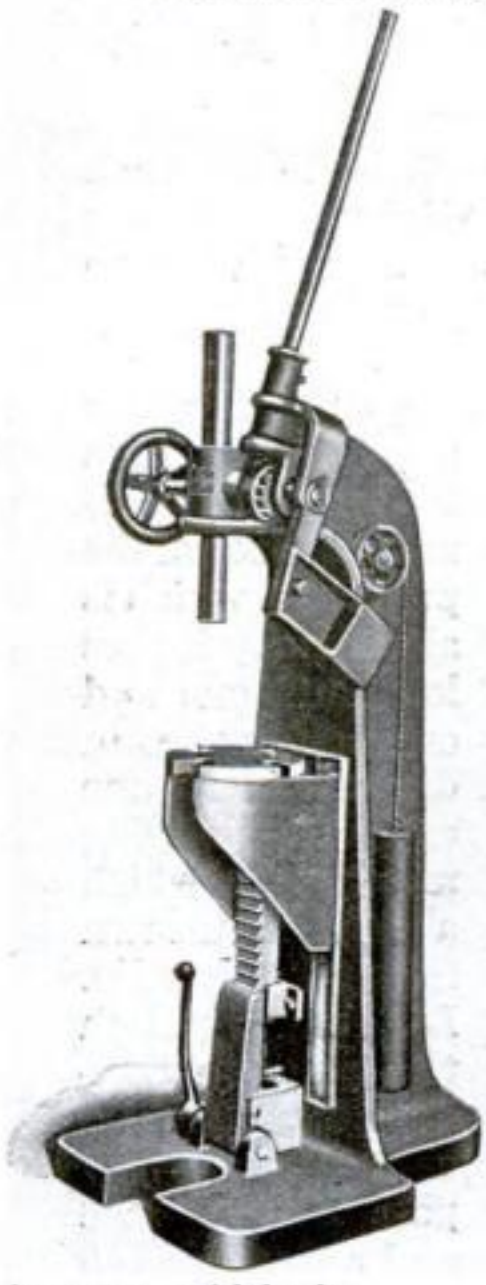
A self-propelled, power-driven elevator which picks up loose material and loads it on a wagon



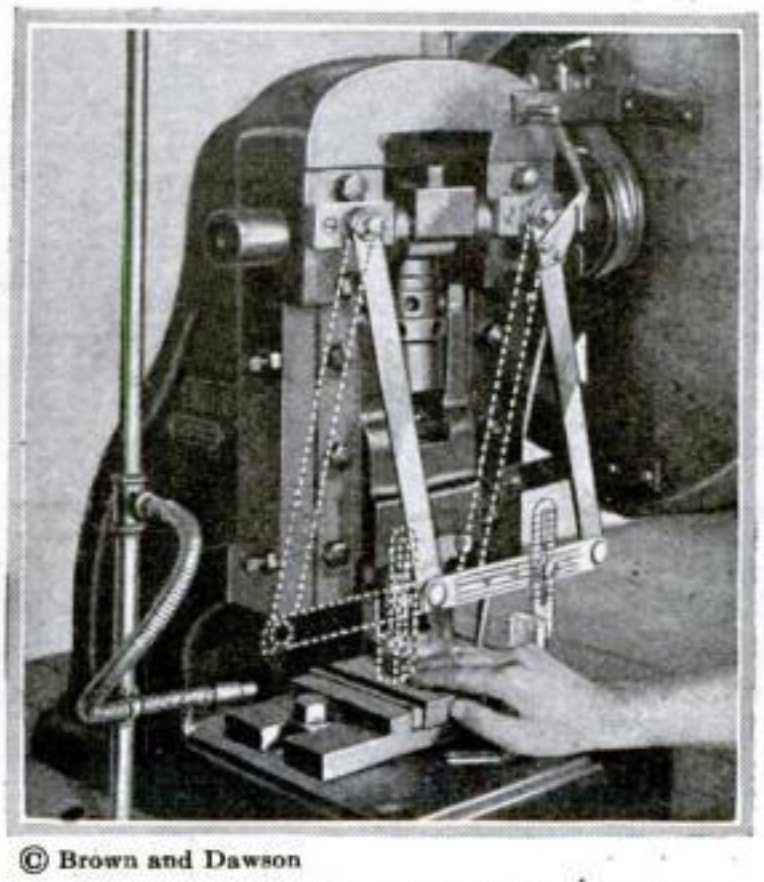
A master truck is used in a munition factory. Lifting or lowering the handle loads and unloads the heavy racks



A special machine for grinding engine cylinders which need to fit snugly



A press which is necessary to adjust and remove arbors from fine work turned in a lathe.



© Brown and Dawson

A safety guard on a die press to prevent injury to an operator's hand

Small disk grinder for pattern makers, cabinet makers and others doing fine work in fitting joints

Hoisting the concrete boat which weighs more than a ton. It is giving as good service as a wooden boat

presented it to the U. S. Naval Reserve Force Auxiliary, at Chicago, which is a part of the Great Lakes Naval Training Station. The boat has aroused great interest, principally because it is the work of a man with practically no knowledge of shipbuilding and with very little knowledge of concrete.

The boat is eighteen feet, six inches long, with a beam of four feet, six inches. It is propelled by a six-horsepower engine and despite the fact that the hull was not smoothed off it is capable of making a speed of ten miles an hour. Concrete, consisting of one part Portland cement to one and a half parts of sand, was applied with a trowel on a carefully designed framework of steel ribs, and was allowed to harden under cover. The boat weighs two thousand, three hundred pounds, twice as much as a wooden boat.

The Great Lakes Training Station Gets Its First Concrete Boat

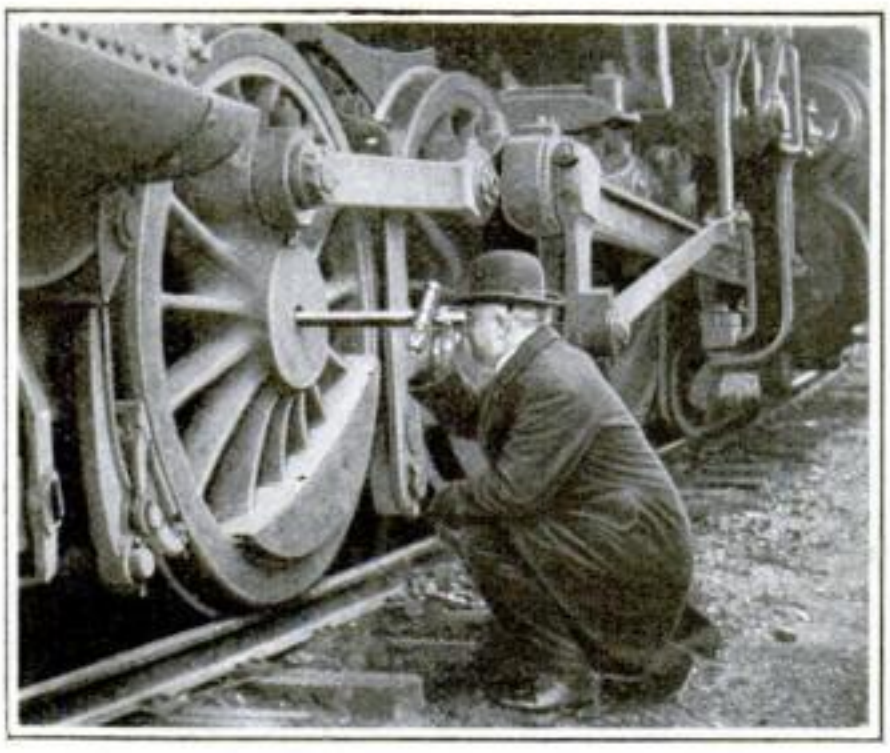
FOR many years concrete has been successfully used for barges and pontoons, but it is only recently that it has been used for other types of vessels. Norway has completed a concrete boat of three thousand tons, and a much larger boat is now being constructed in San Francisco. Montreal and Seattle are centers of concrete shipbuilding and New England shipbuilders are watching the experiment with interest.

The accompanying illustration shows a concrete boat built by Walter N. Dowsey, a lumberjack of Iron River, Michigan. He

Looking Through a Steel Axle with a Periscope

THE periscope, so efficient in trench and submarine warfare, now has a pacific application. It promises to avert many accidents resulting from defective locomotive axles.

The axle is bored longitudinally, the size of the bore being ample to permit insertion of the periscope, which is about forty inches long and one and one-half inches in diameter. At one end is a magnifying mirror upon which a light is thrown from the handle. Looking through the periscope, inspectors obtain a clear view of every part of the axle and are enabled to detect the flaws in the steel.



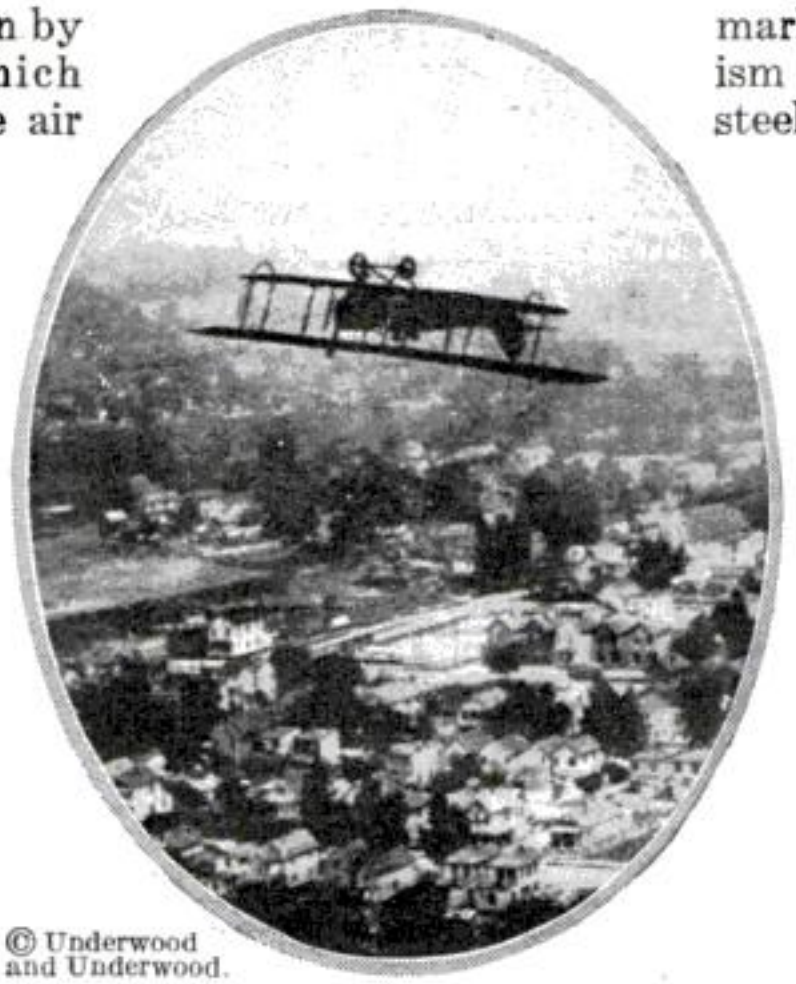
The axle periscope enables the railroad inspector to examine every part of the locomotive axle and to locate flaws instantly

Like a Wasp on the Wing

Is the New Albatross Destroyer in which the Germans have embodied all that the war has taught about fast fighting airplanes

By Carl Dienstbach

THE war will be won by that power which launches into the air the greatest number of the fastest fighting airplanes. This seems to have been realized from the day when it dawned on the general staffs of Europe that artillery must be aimed by a man several thousand feet in the air, that the enemy must be prevented from similarly directing his own fire, and that as a result, fighting machines must be resorted to in order to gain supremacy in the air. As a result, the warring nations have been trying to outstrip one another in producing the fastest and most formidable fighters. British, French, Germans have all commanded the air at different times, and the times usually coincided with the appearance of faster and more improved machines.



© Underwood and Underwood.

Upside Down in Mid-Air

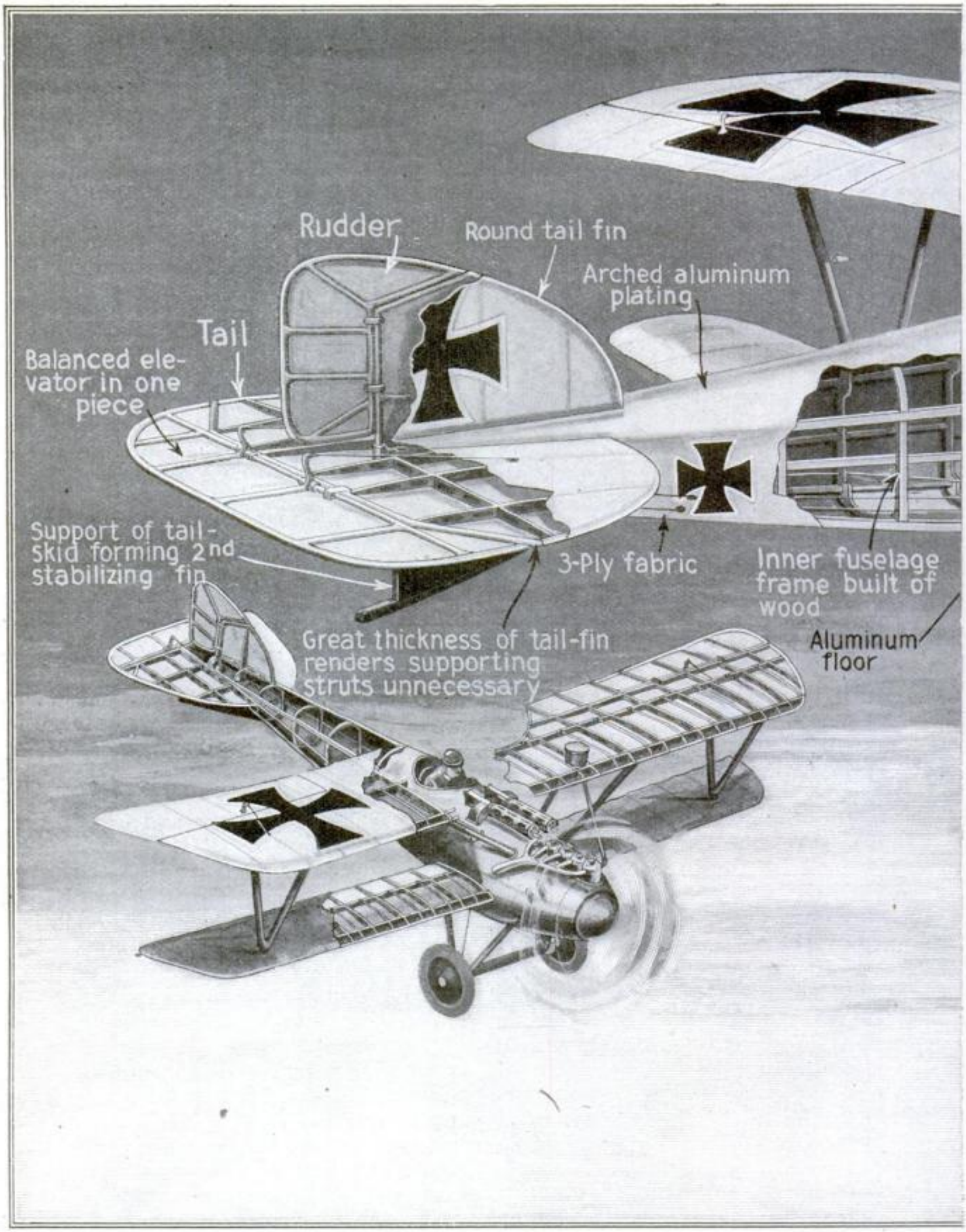
We used to marvel at the men who looped-the-loop in flying machines or slid down sideways or tail first, wondering what was the good of it all. The wildest acrobatic feats performed at flying-machine meetings before the war are now part and parcel of every fighter's tactical equipment. He must put himself in a favorable position and if necessary must loop-the-loop to do so.

Whenever the newest type of hostile machine is captured, it is examined with microscopic minuteness. The curve of its wings, the spacing of its struts, the shape of its fins and tail, the material of which it is made, the proportioning of its different parts—everything is measured, tested and noted. It is not only studied; it is copied. This is no time for riding pet hobbies. The best that the enemy has must be not only imitated, but bettered.

It seems to be conceded in the British and French despatches that the new German Albatross destroyer known as "type D-III" is for the time being the fastest and most formidable fighting airplane on the Western front. In this remarkable piece of mechanism we see embodied in steel, wood and linen, all the lessons so bloodily driven home by two years of fighting in the air. The new Albatross is an amalgamation of the best features to be found in the original small Albatross and the latest fast French Nieuport.

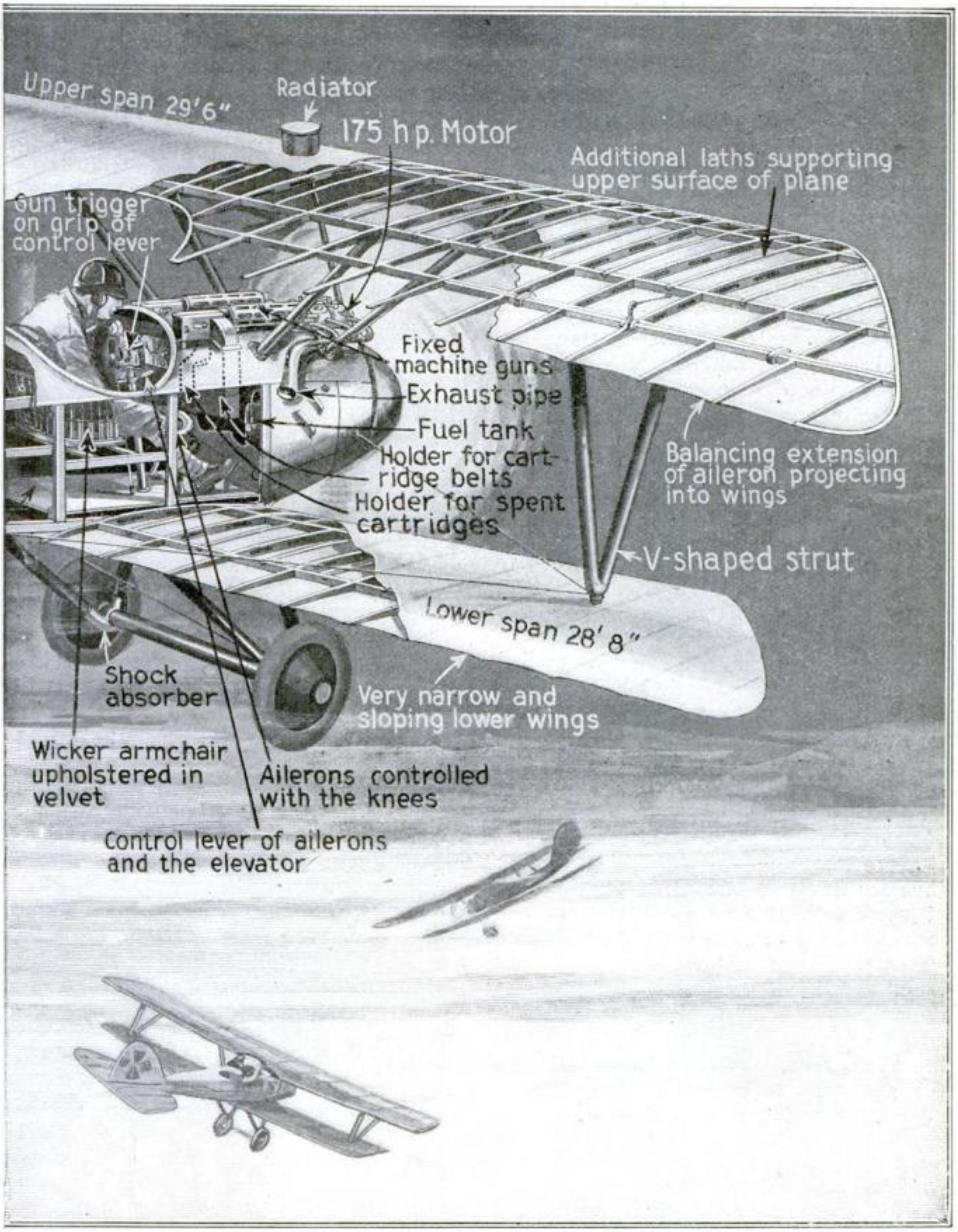
Above all things, a fighting machine must be fast. A speed of one hundred and thirty miles an hour is about the minimum now. In addition to speed, the machine must have the maneuvering power of a wasp; it must be able to dart up and down and in and out with the rapidity of an insect.

In the French Nieuport machine these two essential qualities of speed and maneuvering ability were more highly developed than in any other. The Nieuport is a biplane in which the lower wing is but half as wide as the upper. We look at the Albatross. Sure enough, its lower wing is one-half the width of the upper. In the fast Nieuport, the wings are "staggered"—that is, the lower wing lies not directly below the upper, but slightly to the rear, so that the front edge of the lower wing is just beneath the rear edge of the upper one. Why is this done? Because the struts that tie the two wings together can be shortened. Shortened struts, in turn, mean less wind resistance. Look at the detail drawing of the Albatross that accompanies this article. You see at once that the Albatross, too, has "staggered" wings and short struts.



In their new Alabatross destroyer, which is probably the fastest fighting machine on the machines and have added improvements of their own. A stationary engine of 175 horse-

Why is the lower wing narrower than the upper? There is a kind of interference between upper and lower wings. The air is "caught," as it were, between the superposed surfaces. If the lower wing is narrowed this interference is largely prevented. But there are structural reasons, too, for narrowing the width of the lower plane. Note in the drawing that the struts are triangular in form and that the



western front, the Germans have copied the best features of the French and British fighting power drives the Albatross through the air at the tremendous speed of over 130 miles an hour

rear member of a triangle lies directly behind the front member. Isn't it obvious that the triangular strut thus formed is strong and light and that it will offer less resistance to the wind than if a rectangle with diagonal wire bracing were adopted? Note, too, that the staggered wing construction with the narrow lower plane makes it possible to fasten each triangular strut directly to the lower main beam.

This adds to the strength of the entire biplane.

But the Germans have improved upon the Nieuport in this: They have spread the central struts which hold the upper wing to the fuselage or body, far apart. Hence the two wings are tied together by only two sets of struts—the triangular ones previously described and the central ones. Why was this done? Simply to avoid the use of wires. In the older machines, by which I mean machines that flew in the early weeks of the war, there were a far greater number of wires than would now be considered permissible. Wire bracing extended in all directions. Now, a piano wire which vibrates a distance of half an inch to either side of its normal position offers as much resistance as a rod one inch in diameter. A wire may seem thin, but when it vibrates it is the equivalent of a thick rod. It offers much resistance as a result. And so we find the airplane designers of the world trying to get rid of wires. The builders of the Albatross have gone far in this direction.

From the British, the Germans copied the rounded outline of the tail fins. The tail surfaces of a flying machine have much the same effect as the feathers of an arrow. They steady the machine. The perfect target arrow has rounded feathers. This explains the British tail formation of the German Albatross.

More than any other fighting machine thus far designed the Albatross is shorn of projections. Indeed, the craft approaches a bird in cleanness of line. The water tank, for instance, is no longer found near the engine; it is built into the upper wing. The radiators, through which the cooling water circulates, lie flat against the fuselage or body.

Steadying fins and rudders and ailerons (the hinged surfaces at the rear corners of the upper wing, serving to balance the machine from side to side) must be strong and stiff and yet free from external support. But their wind resistance must be low. The Germans met the situation by giving the fins and rudders a streamline form, which means a shape that parts the air most easily. The steadying effect of a fin depends in part on its area. Additional area was gained very cheaply by filling out the space between the fuselage or body and the tail-skid.

The fuselage or body in which the single fighter sits is noticeably large. But mark the lines. This smooth, correctly designed bulk, large as it is, parts the air with the lowest possible resistance. Note how the fuselage and the wings are tied together so as to get rid of struts and wires. The idea is not new, but it has been so ingeniously carried out that it deserves mention here.

The exhaust from the engine is carefully collected and conducted downward and rearward. Whiffs of exhaust gas should not be added to the tribulations the pilot already has to bear.

It takes a certain amount of muscular effort to swing a rudder quickly. Clearly, the fighter who can swing his rudder most quickly has the greatest maneuvering ability. The muscular effort involved, must not retard a man from making the right turn at the right moment. Hence we find that in the Albatross all the controlled surfaces are balanced, which means that triangular extensions are provided beyond their pivots. You will find this clearly brought out in the tail of the Albatross as it is shown in the accompanying drawing.

Since the entire machine must be swung around in order to aim a gun, it is obvious that as many as twelve guns could be mounted if there were place for them. Indeed, on the Nieuport as many as five have been carried—three on the upper wing and two firing through the propeller. No doubt a similar practice is followed by the Germans. In our drawing we have shown only two machine guns firing through the propeller.

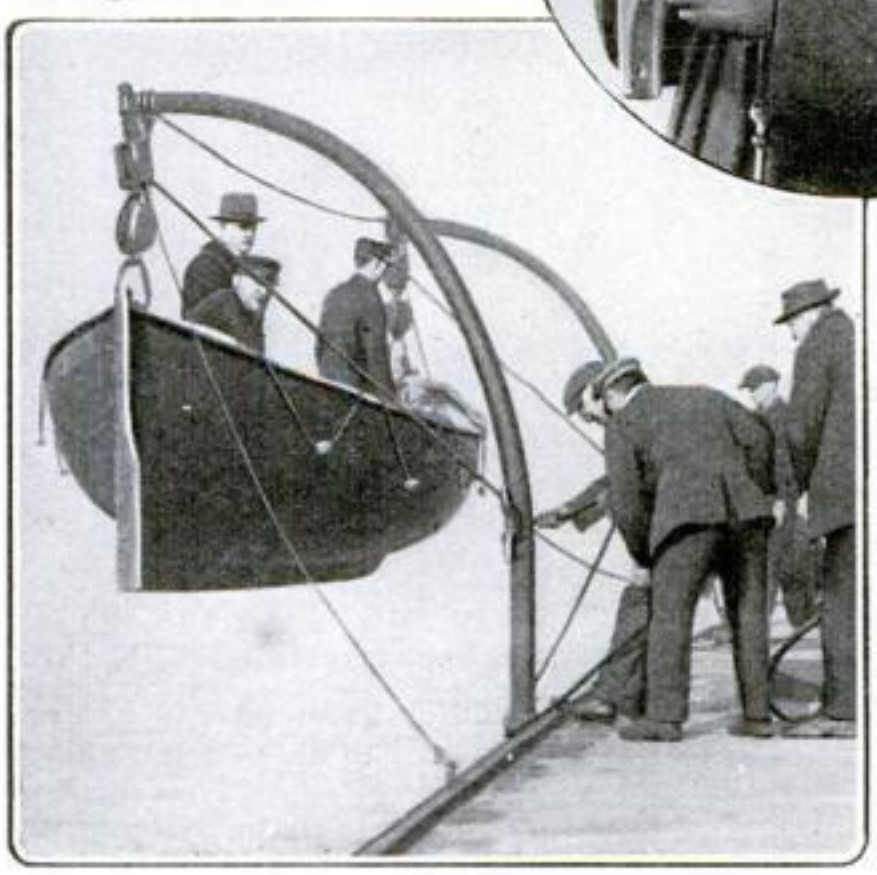
How astonishing it is to find the inventions of fairy-tale writers brought to realization. For years we have been entertaining our children with one of the most beautiful fairy-tales of Hans Christian Anderson—a tale in which a wicked prince rashly essays to fight God himself with ships flying through the air and mounting guns that rain thousands of bullets in response to the mere pressing of a button. Look at the Albatross and you will see the magical buttons attached to the control-lever. Who knows but flying machine designers may find other improvements suggested in what we have been pleased to consider the poetic vaporings of romancers!

You Aren't Spilled Out With This Life-Boat Launching Device

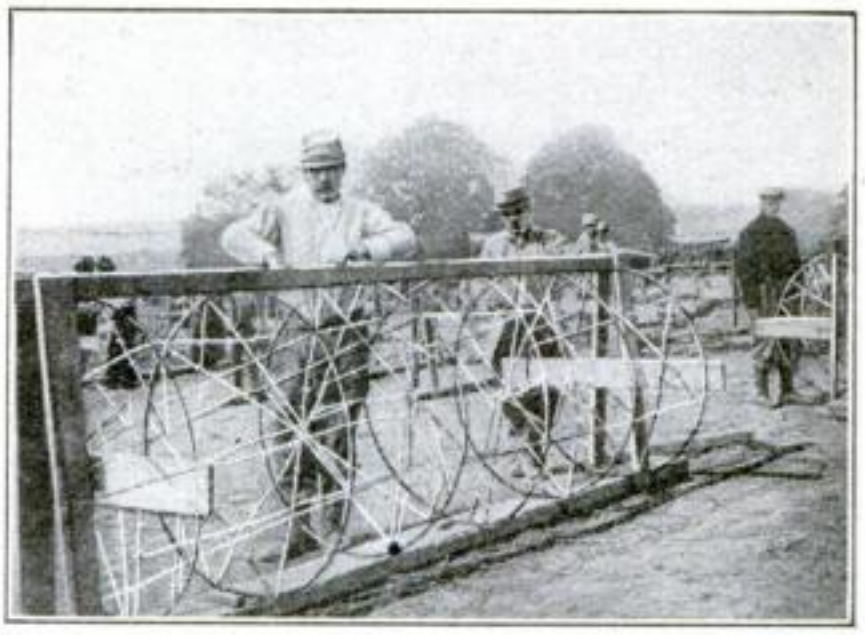
HERE is one of those "do-it-with-a-twist-of-the-wrist" inventions, which, though not at all complicated, seems capable of solving an exceedingly troublesome problem. To launch a life-boat right side up, is the special mission of the invention. Dr. Charles Hunt of New York conceived it. Having crossed the ocean many times, he naturally became interested in life-boat problems. And the machine he produced has been proven by Government tests to be one of the most successful thus far devised.

The trouble with life-boat launching devices at present, is that it is difficult to unhook the tackle blocks, once the boat reaches the water, especially in a heavy sea. Dr. Hunt's contrivance consists of the mechanism which he is shown holding in his hand, one of which is fastened at each end of a life-boat. Ropes run from these to a lever centrally located. If a man in control of the boat pulls this lever even when the boat is but a few feet above the water, the tackle blocks are quickly and safely released, and the craft launches itself right side up, even in a rough sea.

Photos © Int. Film Serv.



Pulling a lever in the center of the craft releases this life-boat upon reaching water



This cylindrical barricade can be rolled over but it cannot easily be surmounted

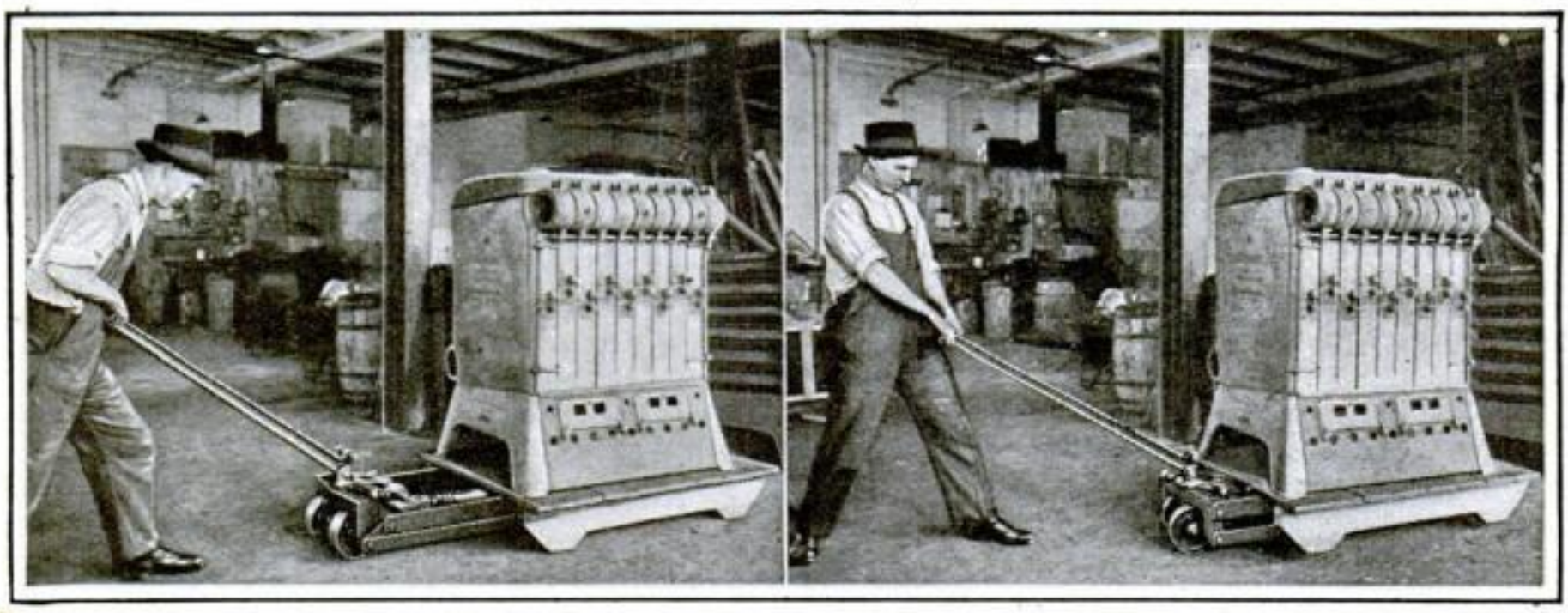
A New Barbed-Wire Fence to Hold the Germans in Check

THE latest barbed-wire fence which the French have designed to check the advance of the enemy, employs a series of immense barrel hoops, on which barbed wire is strung. The hoops are securely fastened to a wooden fence-form—six hoops to a section of fence—so that it is possible for each entanglement section to roll over and over like a string of lopsided pushballs joined together to form a solid unit.

When the sections are to be set up, they are dragged out under cover of darkness and so arranged that the natural land formations of the vicinity conceals them from advancing troops.

Walls Are Suspended from the Roof of This Building

ONE of the queerest structures in the world is an electric-station building at Cristobal, in the Panama Canal Zone. The roof is supported by powerful central columns and the side walls bear no weight whatsoever but are suspended from the eaves by means of cantilever beams. On one side of the building, the wall is made fast to the foundation with anchor bolts. This unique construction was adopted to prevent the building from settling at a dangerous angle, should an earthquake tremor shift the foundation.



Over ten thousand pounds can be lifted by this inexpensive little truck. With it heavy loads can be wheeled about a factory more easily than with the costly traveling crane

What One Lifting Truck Will Do in Factory Hauling

A TRUCK which will lift all but the largest castings upon its back, and then carry its load away with but a single man to operate it, has been introduced into the factories. Its usefulness is almost unlimited.

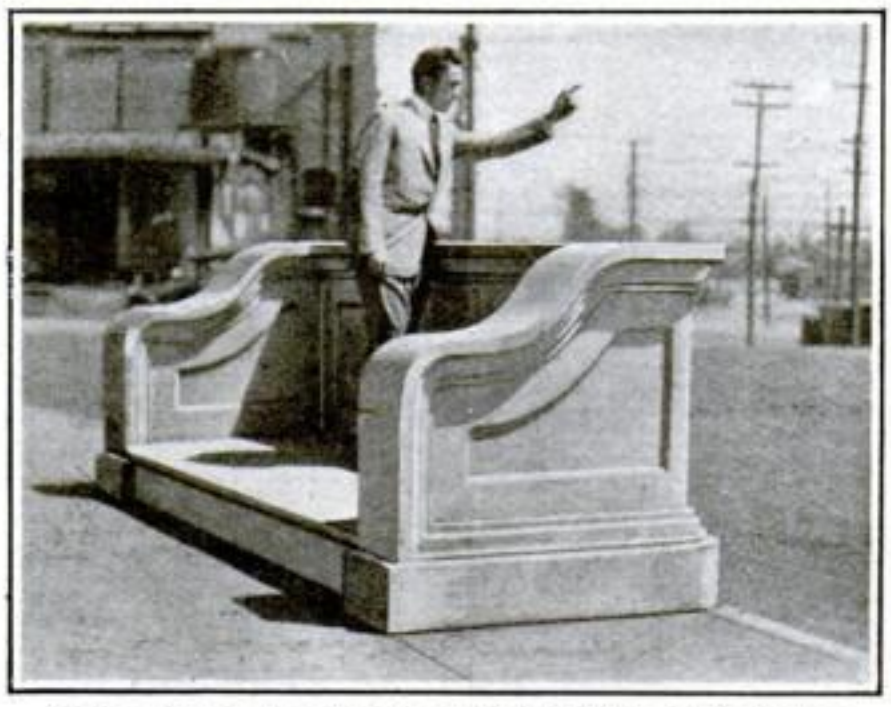
Medium-sized machines in the foundry and shop can now be carried about, not with a ten thousand dollar traveling crane, but with a little eighty-five dollar hand truck. Small castings, such as the little heater shown in the photograph, need not be moved with rollers and crowbars, which require several workmen and precious time.

Each truck is provided with a hundred separate platforms. These are distributed about the shop. When a product has gone through one operation, it is loaded directly upon the platform, on which it is carried from one place to another.

The truck sides are parallelograms. When they are in their collapsed position, the truck is readily slid under the loaded platforms. Then using the truck handle as a lever, the workman attaches a hook upon the stub end of the handle and raises up the sides until they form an oblong. The sides are automatically locked in this position, and the raised load may be wheeled wherever desired. By pressing a pedal on the head of the machine, the sides are tripped. The load is gently lowered by a hydraulic check.

The Soap-Box Orators of Los Angeles Have Concrete Pulpits

THE authorities of Los Angeles, California, have endeavored to beautify their city and to keep the streets free from congestion. The most novel device for the purpose is a cement pulpit. These ornamental pulpits have been placed at specified locations for the free use of street preachers and stump speakers in general.



The stump speaker's pulpit before which the crowds may gather without blocking traffic or breaking any restrictive city ordinance

Escaping from a Straight Jacket in Mid-Air

HARRY HOUDINI, self-styled "handcuff king," recently escaped from a straight jacket, while suspended by the heels, head downward, in mid-air, over Broadway, in New York City. How did he do it?

In order to escape from a straight jacket, it is necessary, first of all, to insure as large a play as possible for the arms. Hence the arms must be pressed out as forcibly as possible, while the straps attached to the hands are being pulled and buckled behind the back. Suppose that the performer is on solid ground. He first places the elbow of the arm passing under the other arm upon the floor, or upon some solid substance, and, by sheer strength, forces it over to one side—an upward pull being exerted at the same time. The position is then changed and the pressure applied to the opposite elbow—an upward pull again being exercised. The arm is thrust back across the front of the body, and upward toward the neck. This alternate movement is carried on until enough play is obtained to wrench the arms from side to side and to work them nearer the neck. Thus "slack" is obtained to pass the strap connecting the wrists, over the head. The buckle, by which the hands are strapped together is brought to the front, and unfastened by the teeth. The sleeves are then pulled down. Next, placing his hands behind his head, the performer can undo the buckles. He can then remove the straight jacket. In mid-air the method is the same, but more difficult. There is no leverage to brace against. Therefore, his escape is nothing short of marvelous.

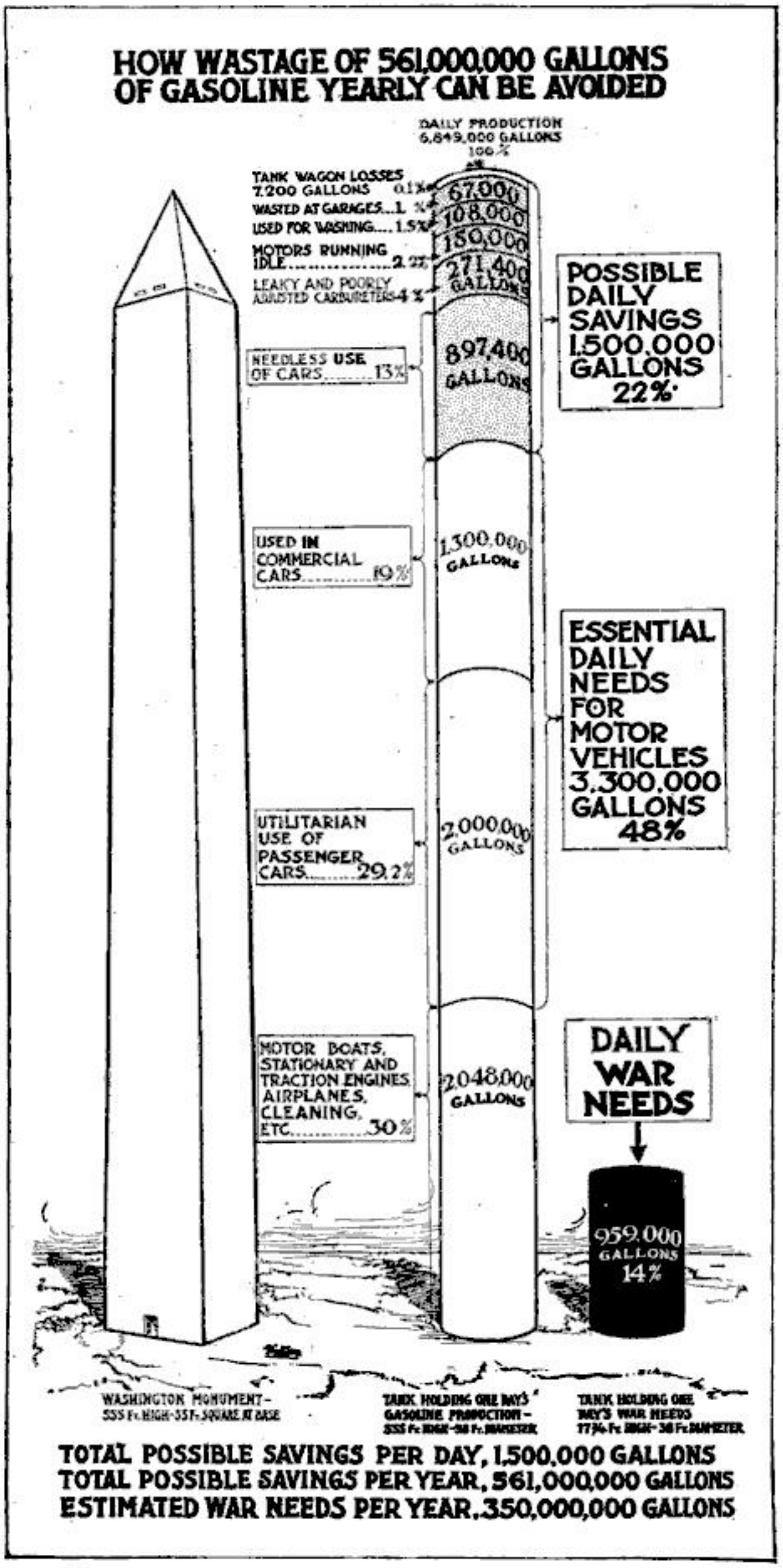
Houdini, hanging over space, ready to make his spectacular escape from a straight jacket

To save a newly paved street from ruin, Cleveland, Ohio, posts a timely warning

Warning the Public to Leave a Newly Paved Street Alone

TO prevent the tearing up of newly-paved streets, Cleveland, Ohio, has set an example which is worthy of serious consideration. Before a street is ready to receive its new covering, warnings are posted, calling the attention of the public to the fact that all underground pipes should be put in at once, because no permits for cutting the pavement will be allowed for five years. The signs have proved very effective in preventing excavating work in newly-paved streets. The people have learned that if they will use a little forethought, the streets of their city need not so constantly be broken up.

Help Do Your Bit By Saving Gasoline



Poster prepared by the National Automobile Chamber of Commerce showing how to avoid wasting gasoline

ONE way to win this war is to insure a sufficient supply of fuel by eliminating gasoline waste. Look at the accompanying illustration and you will see that there is a daily waste of one million, five hundred thousand gallons out of a total daily production of nearly seven million gallons. This is needlessly large.

For war needs of the army, navy and aviation branches, nine hundred and fifty-nine thousand gallons of gasoline must be had each day, which is less than two-thirds of what may be considered as wasted at present. Were owners of automobiles to stop needless mileage, nearly nine hundred thousand gallons of gasoline could be saved each day.

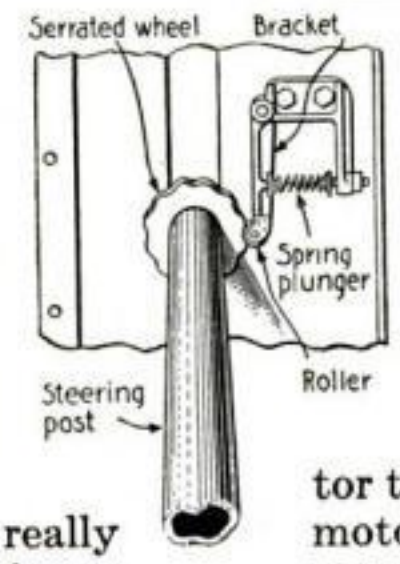
The very highest grade of gasoline is necessary for the thousands of airplanes now building, most of which will use the new Liberty motor, now being made in great numbers in the automobile factories. Great quantities of gasoline will also be required to operate the thousands of army motor trucks to be used by our growing force in France.

Although the production of crude oil in this country has been increasing at a tremendous rate for a number of years, during the past twelve months it has not kept pace with the growing demand.

What Are Shooting Stars? Where Do They Come From?

OUR knowledge of shooting stars extends into the oldest history of humanity, back into prehistoric times. Yet to-day no one knows exactly what a shooting star is, or from where it comes. An hypothesis proposed in 1875 and generally accepted to-day, is that meteorites are fragments broken from small planetary masses by volcanic explosions, brought about by a sudden expansion of gases, steam and probably hydrogen. The broken bits, after their separation, are believed to arrange themselves in swarms which cross the orbit of the earth in accordance with a definite law. Shooting stars, then, undoubtedly come from within our solar system and are broken bits of a world body destroyed by volcanic events. Many meteorites have been found in Arizona.

The stabilizer prevents any serious disarrangement of the steering wheel by keeping it firmly fixed in a given position



Formidable Machine Gun for Young America's Trenches

THE most popular toys are those with which real fighting can be done. Cannons must really roar; guns must really crackle as they fire the imaginary bullets, and machine guns must be mounted on wheels, if Young America is to be expected to approve them.

Master M. Churchill Haenke, the man behind the gun in the accompany illustration, is the proud possessor of a father who can make armored cars that look just like the real thing to the critical juvenile eye. The car in the picture is all the better looking for being homemade. It is equipped with a miniature mortar and a machine gun which makes a racket like the crackle of gunfire, when a crank is turned. Master Haenke supplies his own motive power.

The homemade pushmobile converted into a sputtering machine gun. It gives the impression of being the real thing

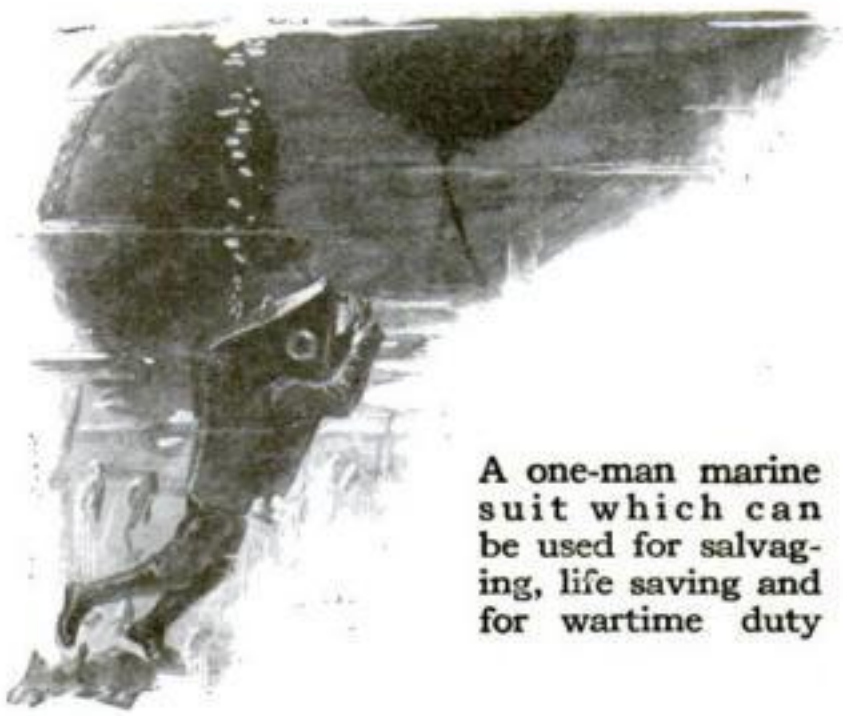
A Stabilizer for the Steering Wheel Makes Driving Easier

MUCH of the strain of driving an automobile or motor truck would be eliminated if every motor vehicle were fitted with a new steering wheel stabilizer. The device is the invention of O. Wm. G. Holmgren of New York city. It is made to hold the steering wheel in the position desired by the driver, without obliging him to keep one hand continually on the wheel. A small wheel with a serrated edge is placed on the steering column beneath the floor-boards, and a spring-tension plunger with a roller-end, is fastened to a bracket which bears against the wheel serrations, one at a time.

When the steering wheel is turned, the friction caused by the spring tension between the roller and the wheel must be overcome before the roller passes on.

Change Yourself into a Fish

Here's an invention that supplies everything a man lacks to swim under water



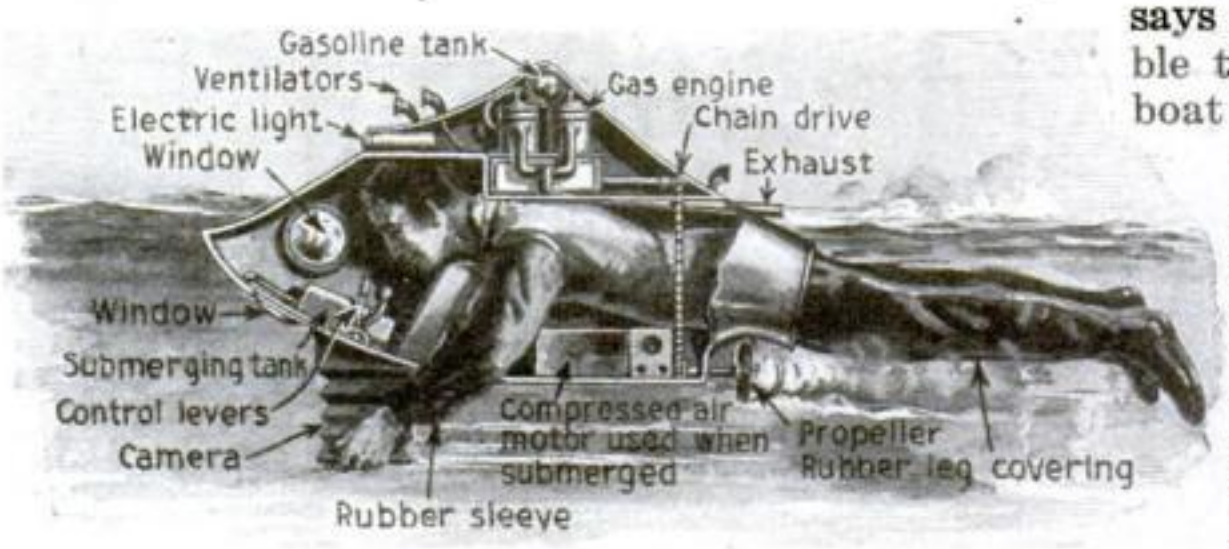
A one-man marine suit which can be used for salvaging, life saving and for wartime duty

IF you know the story of the submarine you will at once see the similiarity between the invention illustrated and the first submarine, built during the reign of King James I. That old U-boat was constructed of wood and was designed to be propelled by oars extending out through holes, the water being prevented from coming in by goat skins tied about the oars and nailed to the sides, to make a watertight joint. In the one-man submersible described here, human arms take the place of oars, rubber and steel supplant goatskin and the propelling power consists of two separate units, one for surface and the other for underwater running, such as we have in our modern submarines.

In its present development, the inventor, Worth R. Barringer, of Denver, Colo., plans to construct the boat of aluminum and to have it take the lines of a big fish. The nose portion has its sides fitted with glass windows and the bottom portion has a telescoping window, so that the operator can guide the vessel where he desires, lying in a longitudinal position with his legs projecting out behind like the tail of a fish. Directly above the shoulders of the operator is a gasoline engine connected with a shaft which revolves the propeller. A compressed air motor with a storage tank takes up the space beneath the operator's body and is to be used when the boat is submerged. Collapsible tanks under his arms correspond with the ballast tanks of a submarine and water is taken in or expelled according to whether it is desired to rise or sink. Levers to operate both engines are within convenient reach. To work them, the operator must remove one hand from its rubber sleeve.

To supply air for the interior of the shell when the boat is running on the surface, floating-ball ventilators are provided which automatically close when water strikes them. The body portion of the apparatus is fastened by straps to the shoulders of the operator, so that he can walk upright with it, or swim in any direction—something no man can do with an ordinary diver's equipment. The boat in its present form weighs about one hundred and twenty pounds, but for navigating work at a depth of one hundred feet or more, it would have to be very much sturdier and heavier than it now is.

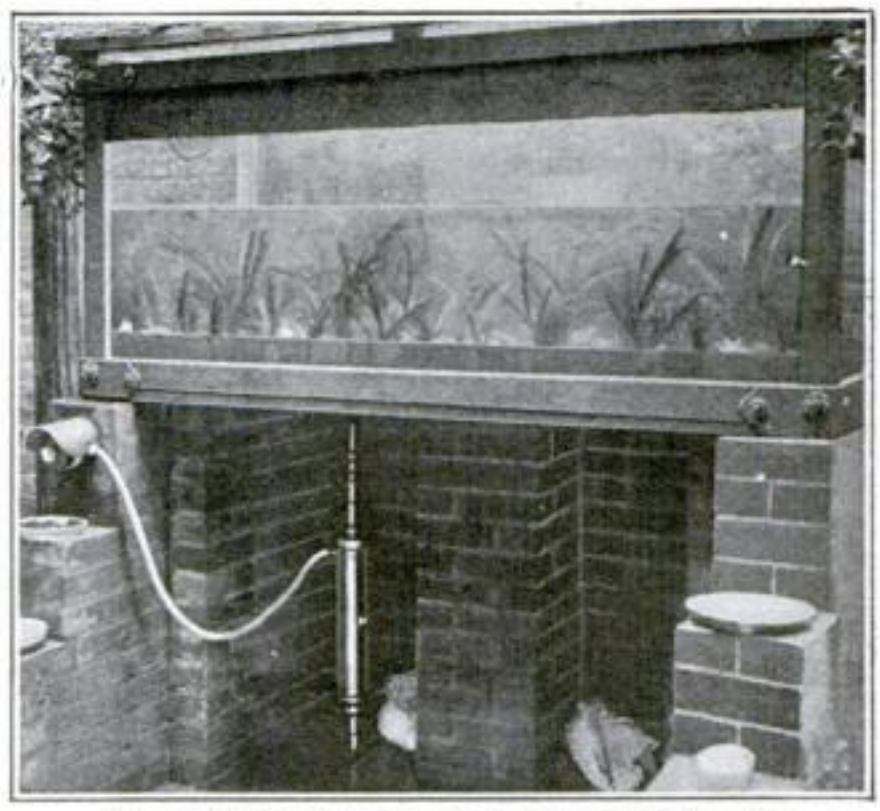
The inventor says it is possible to make his boat the fastest underwater machine in the world, capable of a speed of forty miles an hour, with a radius of action of twenty miles.



The propelling power consists of two separate units, one of them for surface and the other for underwater swimming

The Sugar Shortage Is a Blessing in Disguise

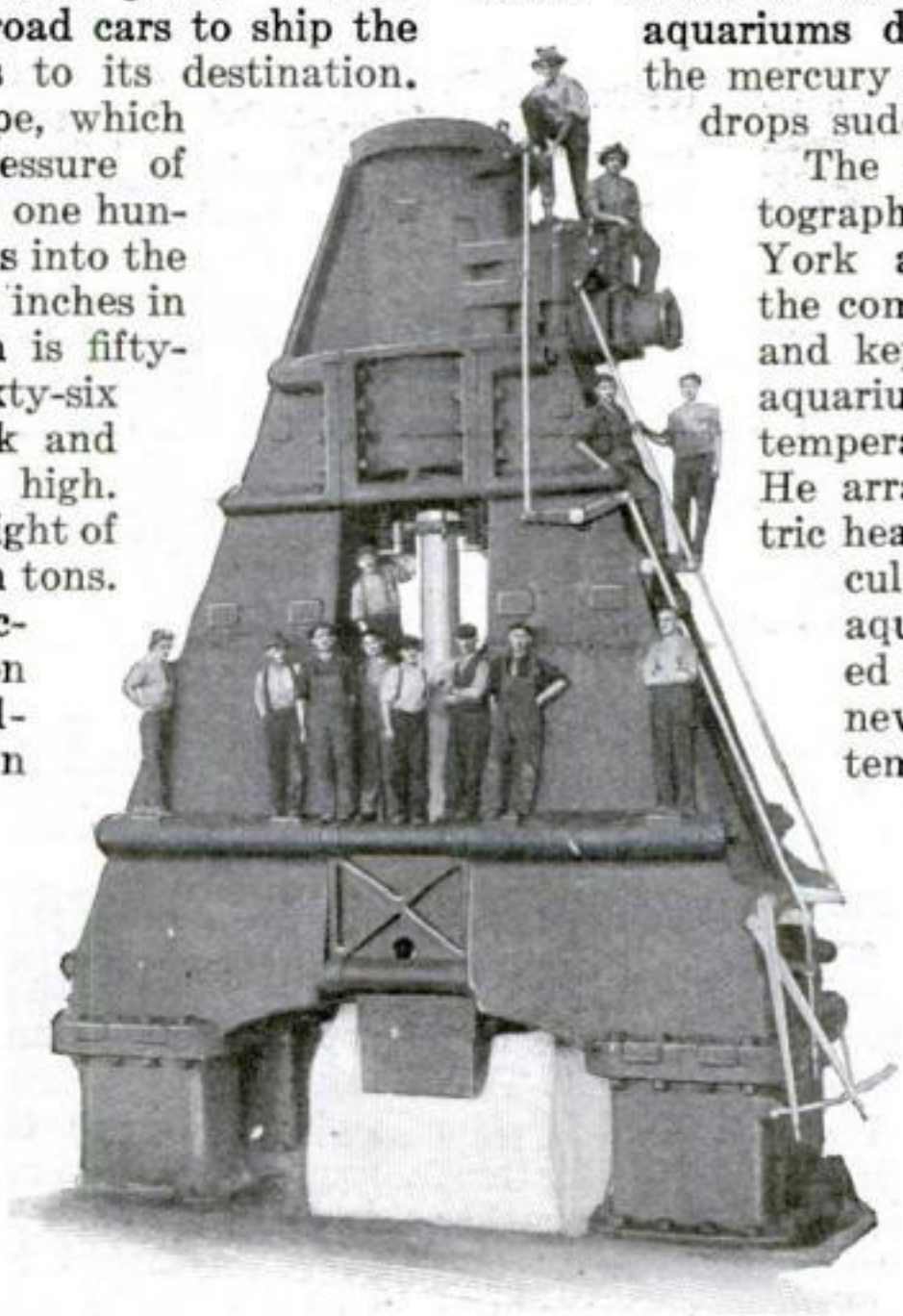
FROM the standpoint of hygiene and economy, changes in diet represent a positive gain. For instance, take sugar—a food which yields more calories per unit of cost than any other food, but which, on the other hand, gives us nothing but energy. It contains no protein and no mineral value, elements which are essential. So the present sugar shortage is a blessing in disguise, for we are obliged to substitute in its place vegetables and fruits, which are real body-building foods. Had we made this simple substitution many years ago we might have been a sturdier race to-day.



A small electric heater arranged in the water circulation system of an aquarium

A Giant Forging Hammer Which Weighs Six Hundred Tons

A STEAM forging hammer which weighs six hundred tons and delivers a blow of eight thousand tons was recently installed in an ordnance plant. It required fourteen railroad cars to ship the hammer in sections to its destination. The main steam pipe, which admits a steam pressure of from one hundred to one hundred and fifty pounds into the giant cylinder, is ten inches in diameter. The ram is fifty-one inches wide, sixty-six inches front to back and seventy-two inches high. The approximate weight of the die alone was ten tons. The whole superstructure is mounted on four massive pedestals. The main cylinder is lined with cast-iron bushing of special mixture. The cylinder proper is mounted between the two main frames and it is securely bolted with body-round bolts, the frames being shrunk together with four large rods.



This huge steel forging hammer is the largest of its kind ever built in the United States

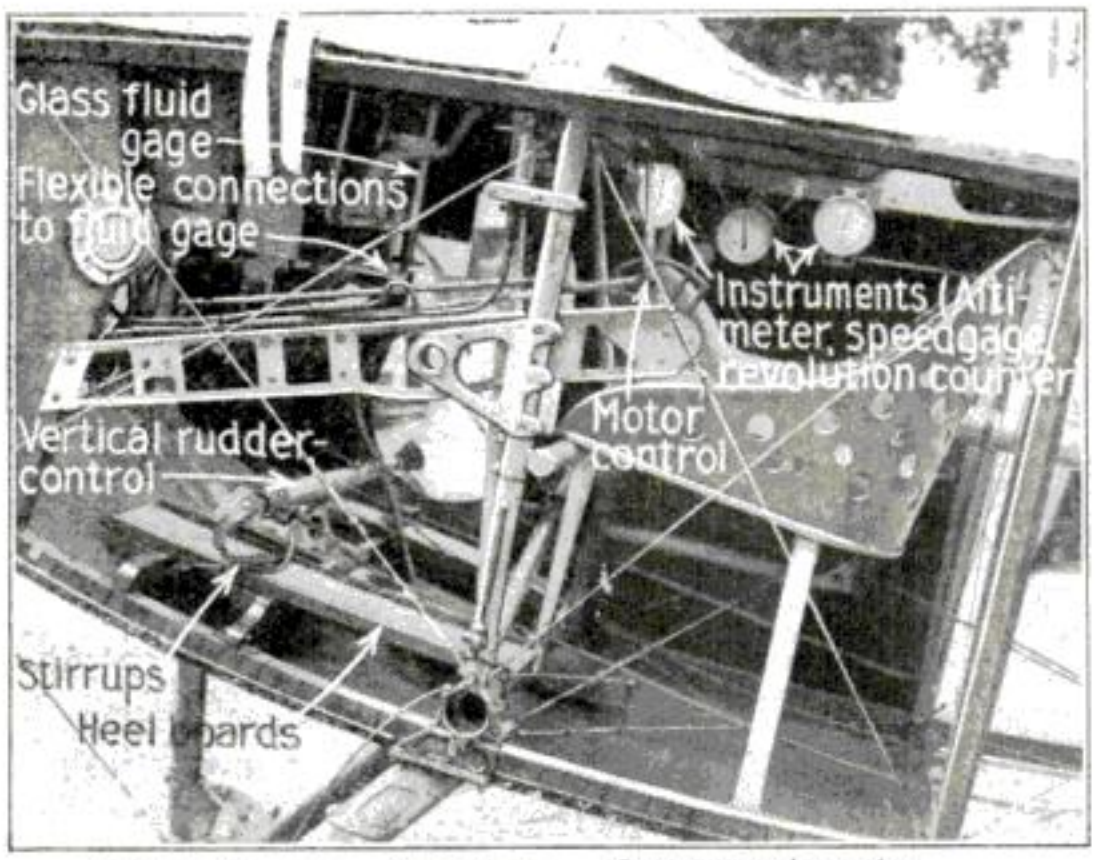
Keeping the Fish in the Aquarium Comfortable in Winter

WHILE it is true that there is no heat provided for the fish in the rivers and lakes during the winter, it does not follow that the fish in the small glass aquariums do not suffer when the mercury in the thermometer drops suddenly.

The accompanying photograph shows how a New York artist provided for the comfort of his gold fish and kept the water in his aquarium at just the proper temperature all winter long. He arranged a small electric heater in the water circulation system of the aquarium and regulated it so that the water never varied from the temperature which has proved most agreeable to the fish. It was interesting to watch the fish swim madly about on one occasion when the heater did not keep the water at just the correct temperature. They noticed even the slight change almost immediately.

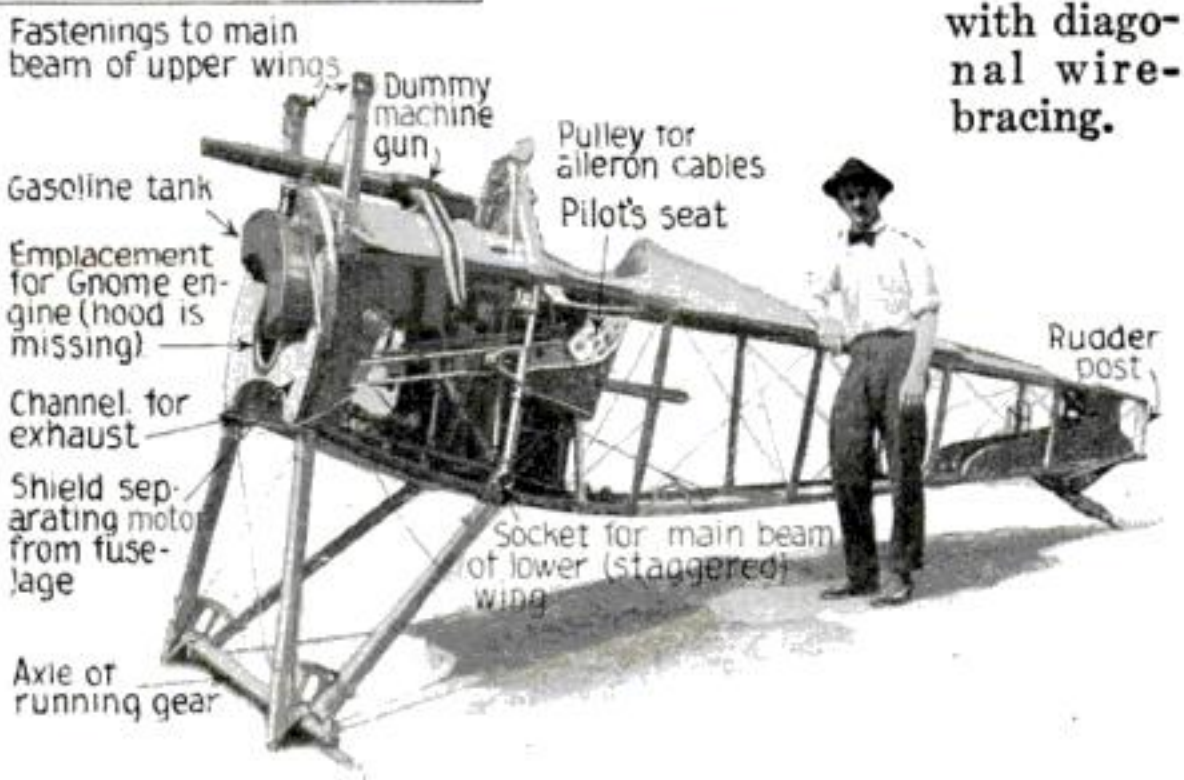
Models for American Airplanes

Our manufacturers are turning to Europe to get the latest airplane designs



Although an American invention, the airplane has received its greatest development at the hands of Europeans. The aviator no longer has to guess. There are instruments under his eyes to tell him everything of importance

At the right is a model which our manufacturers are following closely. Every part has been the result of dangerous experimentation and practical usefulness. Note the position of the dummy machine gun, on top



structural details and proportions that airplanes of to-day are superior to the old machines, not to mention the question of safety. The location of the sockets for the mainbeams of each wing discloses, for instance, that if the lower plane is made much smaller, it should be mounted far enough behind the upper plane so that the struts can be made to converge downward and be fastened only to the frontbeam of the lower wing. This gives a very strong triangular construction, of small air resistance that dispenses with diagonal wire-bracing.

THE machine pictured, is the last word in fighting airplanes that derive the utmost efficiency from the extreme speed and the quick maneuvering and climbing that can be attained by a small, one-man machine. Cutting down the size of the lower plane, makes it superior to other small biplanes. This type has recently been imitated by the Germans in their latest small Albatross fighter, as we point out in another article published elsewhere in this issue.

Parts of the latest Nieuport have been taken to serve as a model for the details of American-built "chasers." It is in

Condemned Army Boots Make Serviceable Roads

WASTE boot leather has been used for making roads, in England. Combining it with slag, granite, limestone, asphalt and bitumen, a material was obtained which possessed the hardness and rigidity of the ordinary tar macadam road and at the same time reduced dust and was more resilient than the usual road. Although it was sufficiently hard to bear heavy traffic, it yielded without cracking on the surface. It was patented in 1910, under the name of "broughite."

Bubbles in the Blood Kill Many a Poor Soldier

SOLDIERS are found dead on the battlefield, with no mark of an injury. Some are lying with arms outstretched as in running; others are grasping their guns as though about to fire—all are in exactly the positions in which they were at the moment of death.

These mysterious deaths do not occur as a result of nervous shock; else the bodies would be relaxed and natural. They are victims of "the bends" or "caisson disease" caused by sudden release from great air-pressure.

When a workman emerges from a high-pressure air chamber, his blood fills with small bubbles, like those of champagne when first uncorked. If the bubbles are large enough to choke the circulation, the man dies. On the battlefield, such occurrences are the result of intense explosion-waves. The blood holds in solution a considerable amount of air and carbon dioxide, the quantities being greater when the pressure is high.

Upon lowering the pressure, the gases separate out as bubbles. In the case of soda water, the bubbles can escape, but in a man they are caught in the capillaries. All muscular action is arrested with lightning-like rapidity, thus preserving the attitude held by the victim before the fatal attack.

No Trouble if This Mirror Drops. It Is of Indestructible Steel

A small steel mirror for the trenches. With it a soldier can shave perfectly

A THREE by four inch mirror, which is intended especially for use in the trenches, is made of a special metal which contains a high percentage of nickel. It will neither rust not corrode.

The surface of the metal is highly polished and reflects almost as well as glass. It is protected by a soft lined case into which it fits.

It is usually carried in the upper left hand coat pocket, where it does excellent service as a shield, being sufficiently strong to divert glancing bullets.

Chewing-Tobacco to Clear Windshields! Would You Believe It?

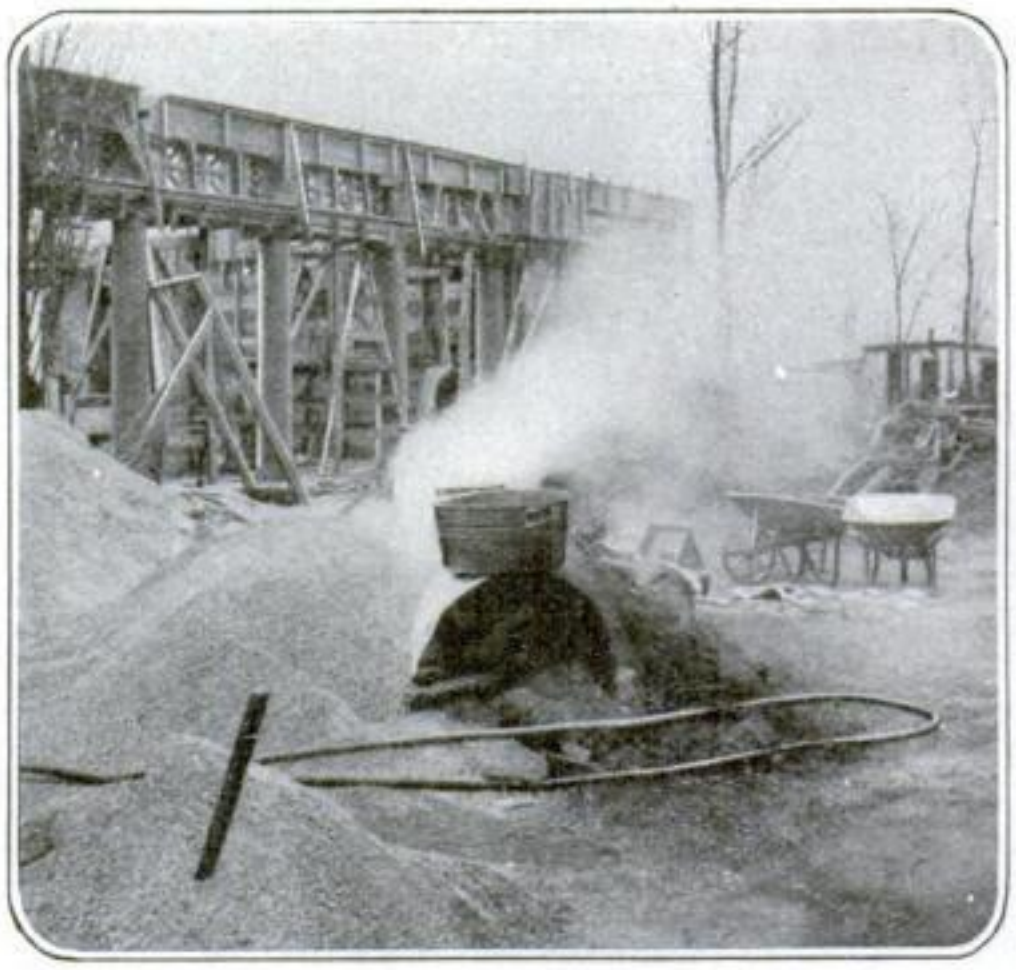
WHILE inventors are trying to devise something that will effectually prevent the fogging of automobile windshields in rainy weather, along comes Theodore Petersen, a druggist in Grand Rapids, Michigan, with a plug of ordinary chewing tobacco and solves the whole problem!

Not only does the tobacco prevent the windshield from fogging, he says, but it enables the rain water to run off the glass without collecting in drops. After each application it is only necessary to rub off the glass with a cloth to remove all marks of the tobacco.

Just rub the tobacco off the windshield with a clean cloth

How One Builder Keeps His Men Employed During the Winter Months

NEARLY all of the concrete foundations for a new lumber shed and a new cement and lime storage shed in Cumberland, Wisconsin, were laid during zero weather. The water and aggregates for mixing were heated, and shavings were packed in a compartment outside the forms to prevent the freshly placed cement from freezing. The cement was left in the forms until spring. When examined it was found to be perfectly good and solid.



The materials used in making the cement during zero weather had first to be heated

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The Newest Type of Cooker Was Invented Two Hundred Years Ago

OUT in Denver, Col., a new type of fireless cooker has been put on the market, by J. E. Crook, which is frankly an improvement on an idea two hundred years old. It is called a pressure cooker and is so small that it may be packed away in your trunk when you go away to the country, or in the automobile when you contemplate a long trip.

It is simply a steam-tight cooker, complete in itself, without the usual box-container. It is made of aluminum, so that it is light in weight and convenient to handle, as well as strong enough to resist the interior 200-pound steam pressure upon which the cooking depends. Safety devices are provided on the cover to take care of the surplus steam. The safety valve is made separable, so that it may be easily cleaned and kept in condition. The steam gage is calibrated to thirty pounds on a dial that can easily be read. When the food has been in the cooker long enough, a thumb-screw is turned to release the steam so that cooking will stop.

The cooker in operation. Note the steam gage and the petcock

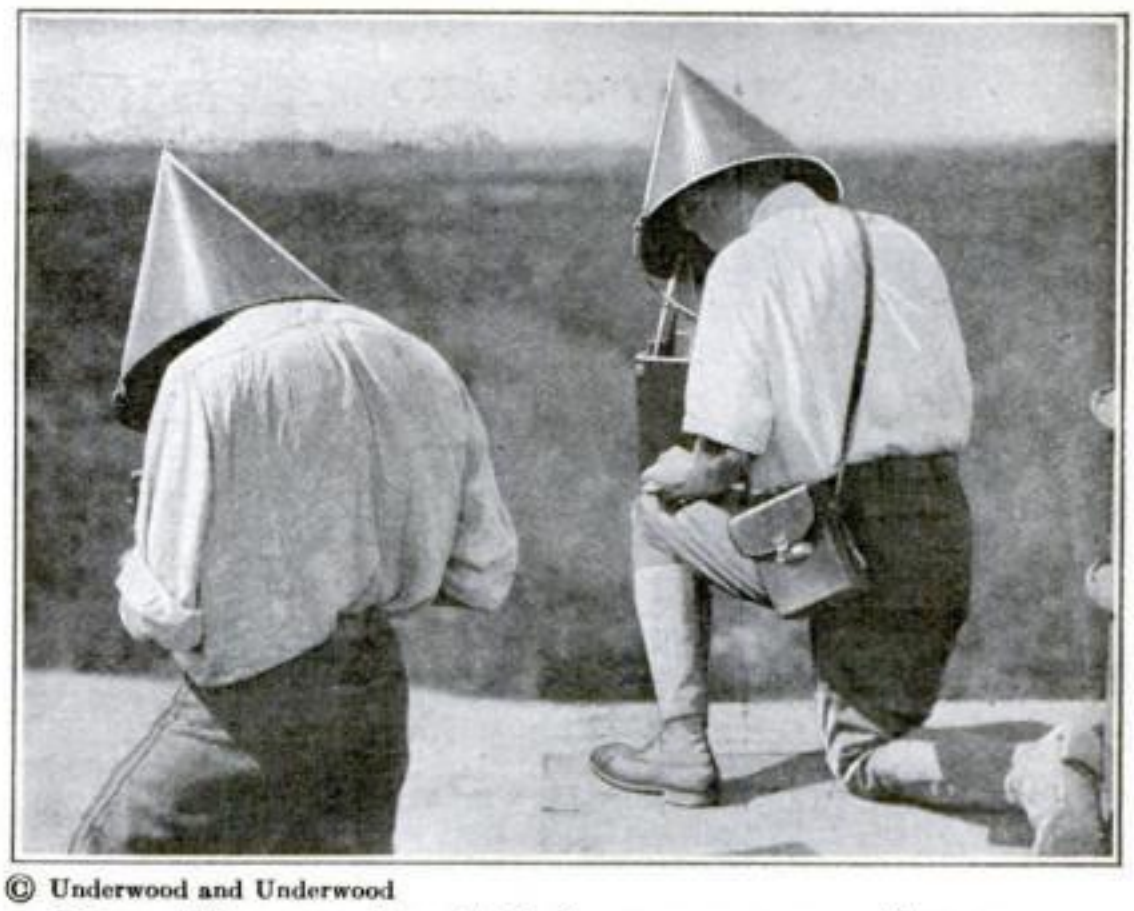
A Novel Operation to Cure Hysterical Deafness in Soldiers

SURGEONS have recently identified hysterical deafness in soldiers as deafness not accompanied by muteness. They are curing it by an operation. The patient is given enough ether to excite him, then two small cuts are made behind his ear. A hammer is then banged on a sheet of iron, and, if the operation is successful, the patient jumps off the table with his hearing completely restored. Before the operation is made, the patient is encouraged to feel that he will be cured.

How the Germans Burrow in Hollow Trees

AT first glance the post shown in the accompanying illustration looks like an Alaskan totem. But do not let its exterior appearance mislead you. Look carefully at the second story window and peering through it you will see a soldier. He gives the secret away. The post is an observation station constructed within the hollow of a shell-broken tree. After it was captured from the Germans by the Canadians, it was left standing on the spot as a relic.

In reality, the post is a hollow structure camouflaged with foliage and bark. Iron sheeting has been placed around the trunk and over it foliage and bark have been draped to give the tree a life-like appearance. Above the second story window is a slit in the bark which would enable a third man to keep watch. Each aperture in the trunk is covered with wire netting to afford protection to the observers from flying shell splinters. An iron ladder, faintly visible in the photograph, enabled the men to climb up or down as they wished. The fact that a trench lies at the foot of the post, made it possible for the observers to take up their positions without exposing themselves to the vigilant enemy. One well-placed shell could have obliterated the tree.



Resembling an inverted ice-cream cone, the war photographer's helmet affords his head and neck full protection from shell splinters, bombs and rifle bullets

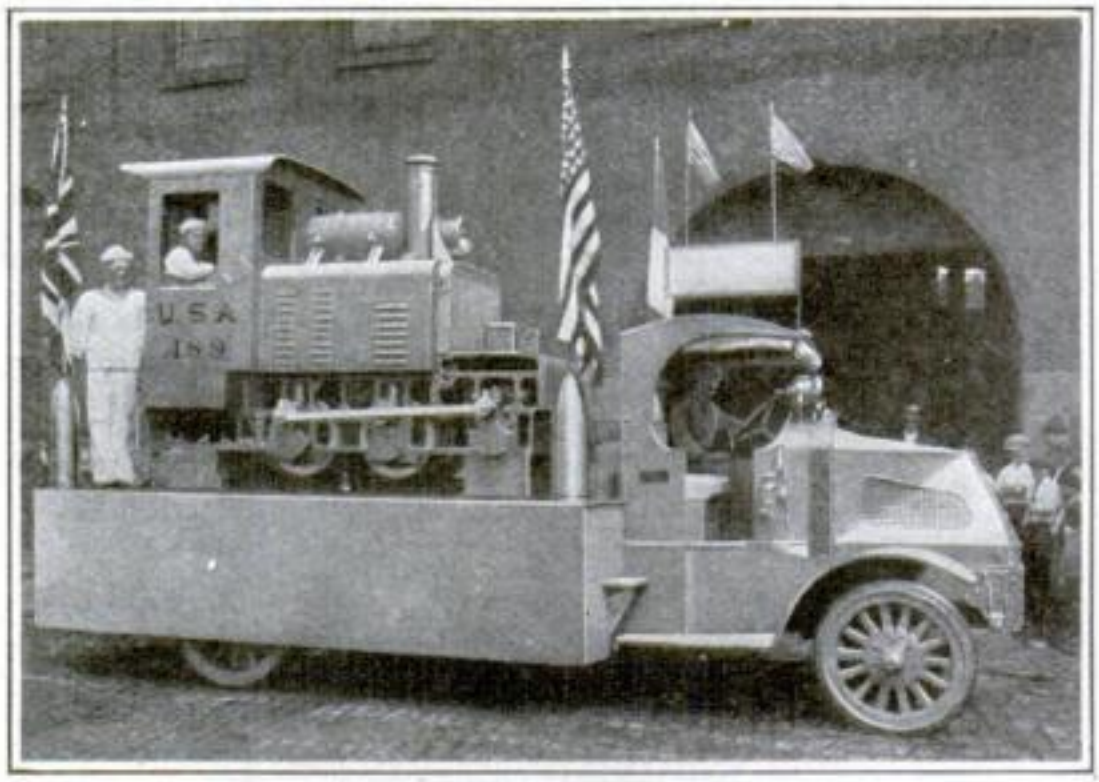
A three-storied German observation post constructed within the hollow of a tree

A New Conical Steel Helmet for the War Photographer

A NEW style in steel helmets has been introduced into the military market to meet the demands of war photographers who are making the pictorial history of the world combat. Resembling, to all appearance, an inverted ice-cream cone, the new helmets completely cover the face, whereas the helmets now in use by the fighters of all the warring countries, merely offer protection to the upper part of the head. With his conical helmet, the photographer can feel sure that his head and eyes will be protected from flying shell splinters and stray bullets. Note that the helmets have carrying handles.

A Little Gasoline Locomotive to Be Used Near Front Lines

IT is so vitally important to bring food and ammunition to the front regularly and quickly that all the armies run whole military trains right up to the trenches. A special locomotive has been designed in America to meet the special needs of the army. It runs on a narrow-gage track two or three feet wide, and hauls a long string of heavily loaded little cars. It is able to turn sharp curves at will. It is propelled by a four-cylinder gasoline engine, mounted inside the hood, just in front of the cab. The exhaust is discharged through the stack. A gasoline exhaust gives little or no smoke, and this assists in keeping the little engine's movements secret. Running in all sorts of difficult places, the locomotive can accomplish a great deal of work, all without revealing itself to the enemy.



This little locomotive can haul several cars heavily loaded with supplies for the boys in the front trenches

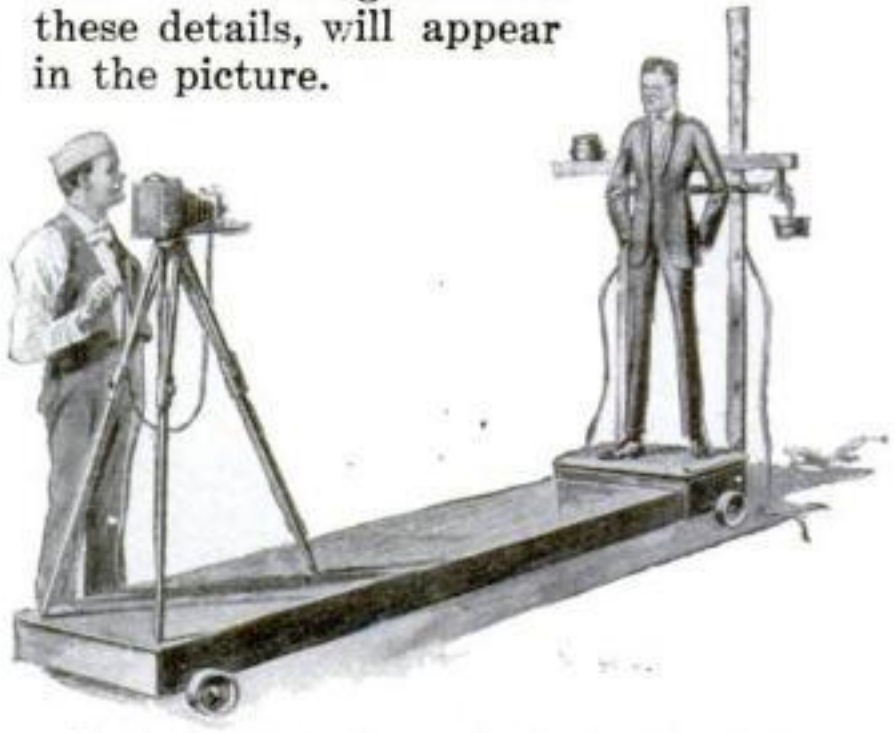
How the gasoline motor is connected with the driving wheels of the locomotive is interesting. Imagine the cab and other superstructure as mounted on the front end of an automobile running backwards, and you have the underlying idea. Where the rear wheels would be on an automobile is a small crank mechanism, visible just under the front "steps" of the locomotive. The four cylinders of the motor lie lengthwise under the hood, just as they would in an automobile. They drive this crank through the medium of clutches, transmission, and power-shafting in the same way as they would the rear axle of an automobile. Power is transferred from the crank-mechanism to the driving wheels through the aid of connecting rods.

"The Measure of a Man," to the Inch—by Photograph

IF you are a busy man and do not like to use up a lot of your valuable time in being measured for your new suit of clothes, you can have your measurements taken in the twinkling of an eye, by photograph.

This is the basic idea of a patent granted to Emery E. Costly, of Walkersville, Maryland. His invention will indicate not only the measurements of a man but his weight as well. The apparatus consists of a platform on which is mounted a camera, a scale, and a height measuring standard on the end of a platform scale.

There is no tiresome standing as there was when the tape measure did its slow work. All the prospective customer has to do is to stand on the platform opposite to the camera. A measuring device behind him will record his height and other measurements and scale his weight. All these details, will appear in the picture.



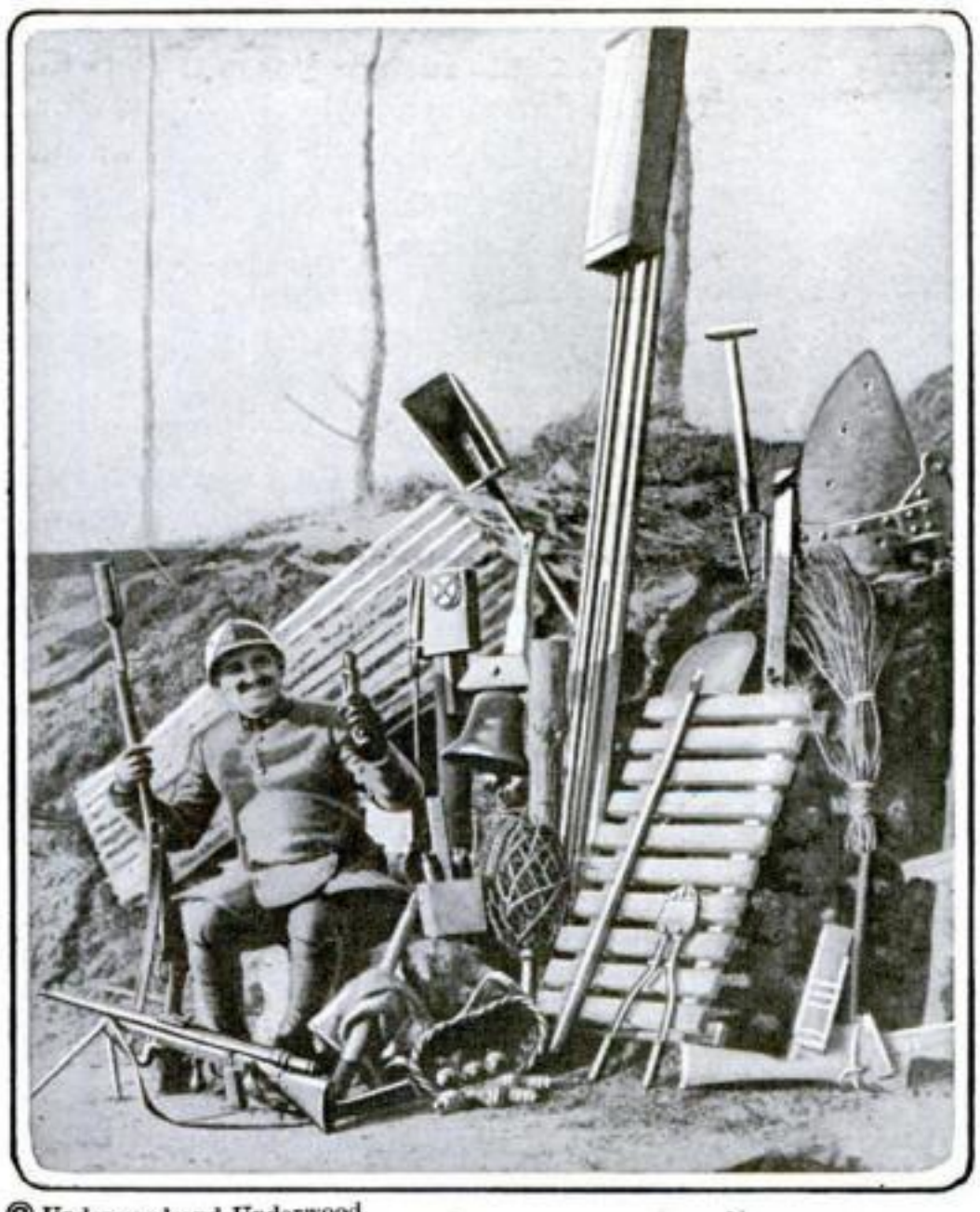
Be photographed on this platform and the resulting picture will indicate your height, your weight and your measurements

The Modern Soldier's Fighting Equipment

THE equipment of a French infantryman in Napoleon's day consisted of a gun and a knapsack. To-day the soldier carries an array of death-dealing weapons as complete as that of the arsenal itself.

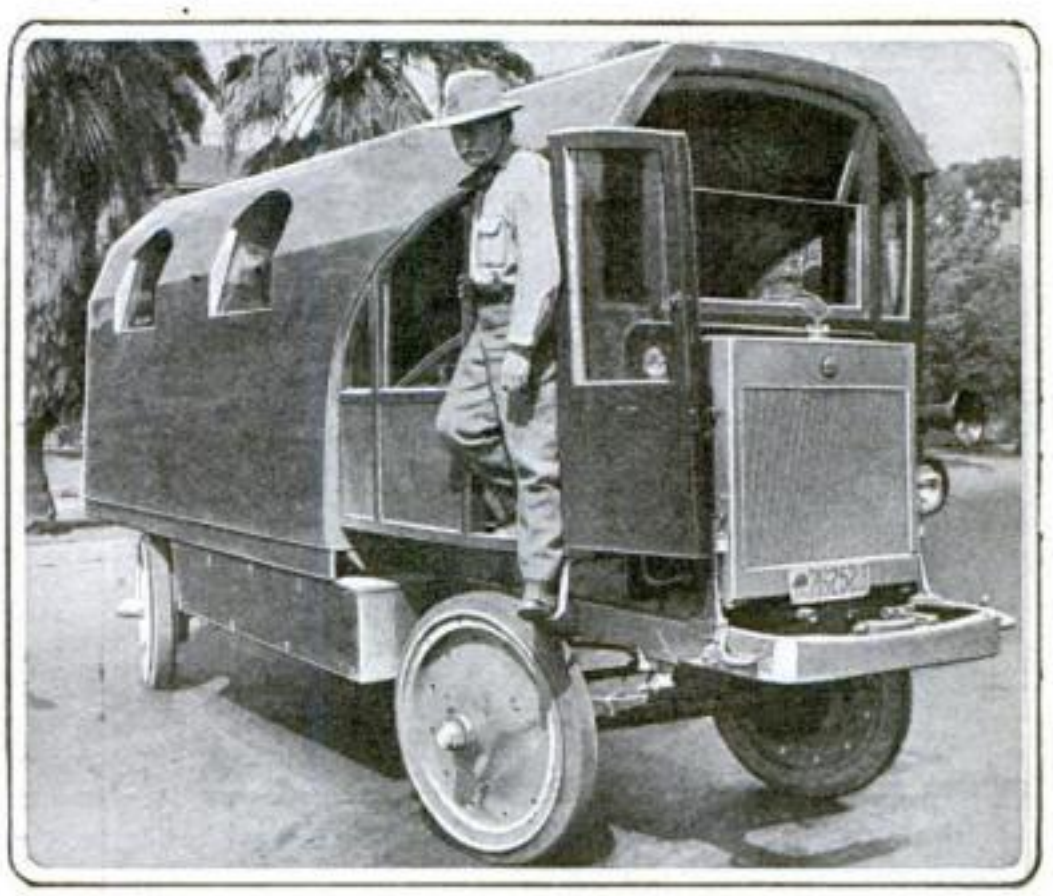
Hand grenades and gun grenades, wire shears and a rifle are carried by the foot soldier in the advance. Pick-axe and shovel he must have when he reaches the trenches. Signal lanterns and sky-rockets must also be carried by the officers to keep headquarters constantly in touch with the progress of the fight.

The periscope and the gas alarm are as necessary as guns. Add to all these the other implements of war and you will understand why physical fitness is the principal consideration in the examination of recruits.



© Underwood and Underwood

The modern soldier carries more than twenty implements of warfare in addition to his gun and blanket. Is it any wonder he has to be strong?



A nature lover had the body of this automobile fashioned out of a hollowed redwood log

A Traveling Home Made From a Giant Redwood

TO construct an automobile body out of a section of a huge redwood tree is a feat recently accomplished by Charles Kellogg of Santa Clara, California. Mr. Kellogg is well known as the first man to imitate birds with his voice.

To accommodate this unique redwood body, an especially-designed chassis was constructed. Then Mr. and Mrs. Kellogg traveled to the Eel river country, where many mammoth redwoods grow. Here they secured from a lumber company a section of one of the large trees. The section chosen was twenty-two feet long, thirty-three feet in circumference and weighed forty tons.

One-half of this piece was cut away, and the selected half was hollowed and the bark was removed. It was then jacked up and the chassis was run beneath it. When dried, this finished product weighed about five thousand pounds. The car has been fitted with windows and doors, and the inside has been equipped with beds, kitchenette, closets, electric lights and all traveling conveniences.

If you have lenses you are not using, emulate the example of this man and enlist them in the army. The officer shown in the picture above is Captain Dawson, who used to make photographs for the "Popular Science Monthly"

Have You a Camera Lens? Enlist It in the Army

THE Signal Corps of the Army needs lenses for cameras to be used by the fleet of observation airplanes now being built. If you have a lens of the required type, do your bit by enlisting it in the service of the Army. Write to the photographic division of the Signal Corps, U. S. A., Mills Building Annex, Washington, D. C., stating what you have on hand and what price you want.

Because the camera lens is the eye of the Army and because German lenses can no longer be bought, a serious situation has arisen. The Bureau of Standards, of the Department of Commerce is now perfecting a substitute for the German "crown barium" glass.

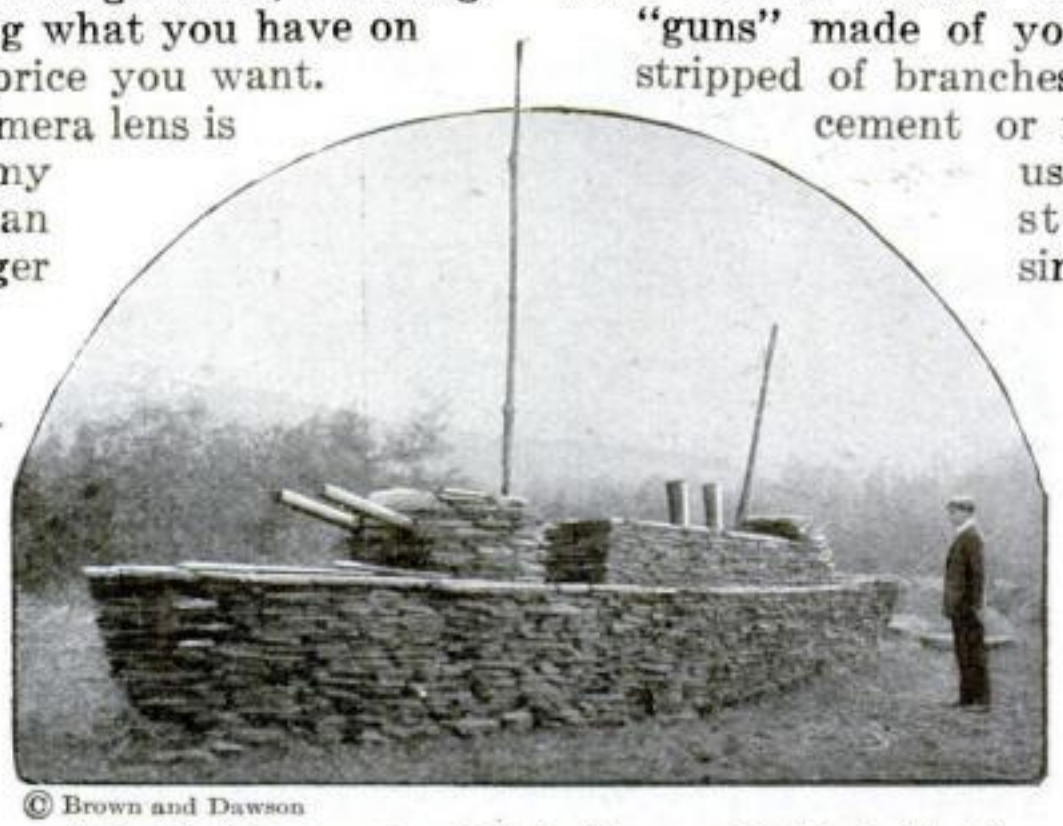
A Battleship Made of Stone—A Landlubber's Feat

ALTHOUGH four months of his vacation went into the building of a stone battleship, John von Wiegand of Brooklyn, N. Y., is proud of the monument which tops a little hill of broken rock, overlooking a stone quarry at Haines Falls, N. Y., in the heart of the Catskill Mountains.

Mr. von Wiegand is a retired police inspector, having passed the age limit of the service. A little over a year ago he spent his vacation in the Catskills and conceived a plan for building a structure out of stone. His choice settled on a battleship.

A number of boys, seeking some form of diversion, soon became interested in Mr. von Wiegand's plan. To each one he gave a time card on which was kept an accurate record of the working hours. So, aided by his staff of juvenile engineers, the former police inspector constructed his battleship step by step.

The ship measures twenty-eight feet in length and eight feet in beam. It is built entirely of flat stone slabs of varying sizes and shapes. The funnels consist of short lengths of tree trunk, with the bark left on. The masts are merely young trees with the branches stripped. The decks and roof of the superstructure are of large flat slabs of rock, such as are used for sidewalks, while the turrets are shaped with curved stones and armed with "guns" made of young tree trunks, stripped of branches and bark. No cement or mortar has been used for holding the stones together, since the weight of these components is sufficient to keep them in place. In the vitals of the battleship has been placed a bottle containing a record of the names of the constructors.



© Brown and Dawson

A battleship twenty-eight feet long, which is built of flat slabs of stone. The funnels are short tree trunks

What? A Poisoned Sea in the Atlantic Ocean?

FOR the eighth time since 1844 fish have been killed along the west coast of Florida in an area of poisoned water. Not only the water, but the air has been charged with a suffocating gas, odorless but irritating to the air-passages. The last mortality was reported in October and November of 1916. The Bureau of Fisheries sent experts to the spot but they were obliged to admit, after a careful investigation, that the cause of the strange occurrence is a mystery. One explanation advanced is that earthquake shocks, possibly due to West Indian hurricanes, released poisonous gases from the sea-bottom.

Using the Exhaust Gas to Make the Engine Start Easily in Cold Weather

A SIMPLE device to make your automobile engine start easily in cold weather and to prevent it from sputtering before it gets warmed up, is shown in the accompanying illustration. It consists of a length of one-quarter-inch brass gas pipe screwed into the exhaust manifold and then wound around the intake manifold between the carbureter and the cylinders. The free end of the pipe is then bent downward and backward under the car, so that the small amount of exhaust gas passing out of it will not be disagreeable to the driver or to the passengers. It takes about six feet of pipe to make the device. The heat of the gas in the pipe warms the intake manifold so that the incoming fuel is heated and more completely vaporized. This gives additional power because of the greater heat and effects a considerable saving in gasoline. It also prevents carbon deposits.

The heat of the exhaust gas warms the intake manifold, vaporizing the fuel

An ice formation resembling a giant cauliflower. It remained solid for several weeks

A Giant Cauliflower of Solid Ice. It Was Twenty Feet Tall

DURING some freezing weather in Alberta, Canada, the device which takes care of the overflow from the oil well, shown above, was out of order, and the gas and water squirted high in the air, freezing as it fell. In about a week's time, a beautiful ice formation resembling a giant cauliflower ornamented the side of the building, and reached twenty feet in the air. Its beauty was augmented when the sun shone.

The Motor Truck of Democracy

It's old and yet it's startlingly new. Fifty experts sacrificed their pet hobbies and buried the hatchet of competition to produce it

By Joseph Brinker

THE Motor Truck of Democracy, otherwise known as the standardized war truck of the United States Army, is the greatest achievement of America's motor-truck industry. And why? In the first place, it was conceived not by one man or one company, but by fifty of the master motor-truck engineers, each working with patriotic fervor on his share of a great task, each backed up by a company which had heretofore engaged in almost cut-throat competition. That these fifty experts representing competing firms have worked together harmoniously, picking out the good points of one design and often ruthlessly throwing aside pet hobbies which had been followed for years before, but which did not meet the requirements of war, is an exhibition of self-repression as magnificent as is the truck they designed. Long after the war the influence of these patriotic engineers will be felt. Not only the army but the business men of the country have profited by their co-operation. The commercial motor-truck will henceforth be differently built.

What is the chief merit of the new war truck? Why is it great? Chiefly because it is a standardized vehicle down to the last nut and bolt. That is why it is a better product than any truck used at the front today.

The average commercial motor truck is not rugged enough to stand the severe tests of war. Our army engineers found this out in our effort to catch Villa in the Mexican wilderness. Our trucks were good commercial products, but they broke down. That was but natural. Some vital part was just strong enough to give sufficient overload capacity over fair to middling roads and just weak enough to break and cause trouble under the excessive strains of war work when negotiating roadless country.

It is not strange that the average commercial truck should fail under severe war tests. It is primarily a business-man's money saver, for use only when it will

Photo © by Harris and Ewing

President Wilson Accepts the Liberty Truck

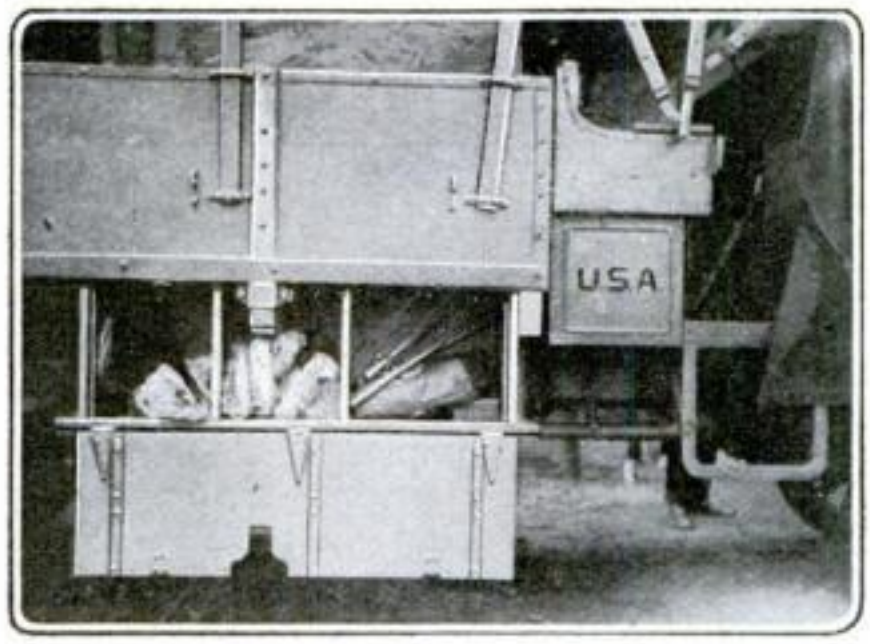
Although it represents everything new in design it embodies only tried and proved ideas

The War Chariot of the American Army

Rugged and massive in appearance, the truck has worm final drive with a large gear reduction between the engine and the rear wheels, so that exceptional power may be had at slow speeds. It is fitted with the conventional caravan-topped army body, and with spring-supported wooden bumpers in front and at the rear to avoid damage in convoy formations.

deliver a ton of goods more cheaply than any other vehicle. Its weight is reduced to a minimum so that its power can be applied to actually moving the load, rather than to pushing itself over the road. Greater strength demands heavier and more rugged parts and this means greater weight.

Some truck makers wondered why it was necessary for the United States Army to have a special and more rugged conveyance, when our Allies across the seas were not only using the 54,038 commercial vehicles shipped to them from America between July, 1914, and July, 1917, but were continuing to order more each month. That was all a matter of sheer necessity. The repair-parts problem is stupendous, because of the inherent weakness of the average commercial truck for war work. The trucks couldn't be changed. A single change in design of any of the dozen or more standard makes sent to the battle front would mean the scrapping of thousands and thousands of dollars' worth of spare parts. Our trucks overseas are giving a good account of themselves; but they are not all that has been desired.



Stirrup Step and Storage for Spare Parts

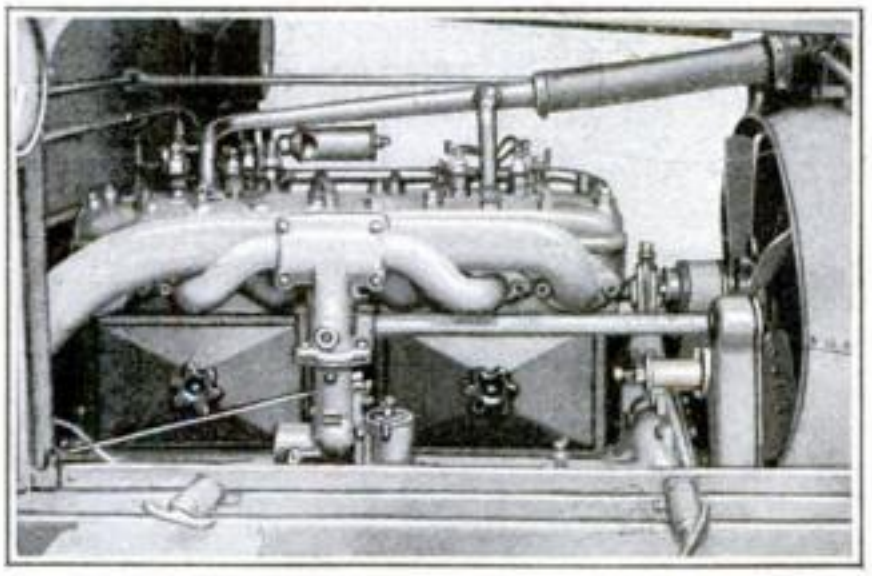
The clumsy automobile running board with its tool boxes and extra tires has been discarded

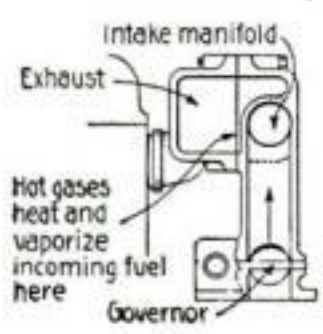
When our Allies bought American trucks they *had* to buy them, not because they were built in the right way but because trucks were vital necessities and America was the only country able to make and export them. To change even the smallest detail on any of our trucks now abroad would throw the entire repair parts system into chaos. Battles might even be lost if the system were disturbed.

But with the United States, it is different. We are entering the war at a time when we are able to apply every bit of truck experience gained by our Allies at the cost of much blood and money. This experience is embodied in the new trucks, the first two of which, were assembled in record time at plants in Rochester, N. Y., and Lima, Ohio, driven overland to Washington and accepted by President Wilson and Secretary of War Baker.

The weakest part of the new truck is stronger than any conceivable war strain that can be put upon it. It is more rugged that any commercial vehicle of like capacity. Its load is only three tons, and yet it is comparable with the five-tonner of every-day use. This is very important; for there will be neither time to make extensive repairs when the forward march on the West front begins, nor roadside repairshops at which to make them. A broken-down truck is a truck lost. Into the ditch it will go, so that the line of vital ammunition and supplies is not held up. Again, the shell-pitted roads of northern France, over which the advance will be made, will be boulevards as compared even with Mexico's roadless country.

In order that our new trucks shall not fail in this crucial test, the two already completed, will be tested to destruction between now and the first of January, 1918. Any weaknesses which might prove disastrous later on will be dis-

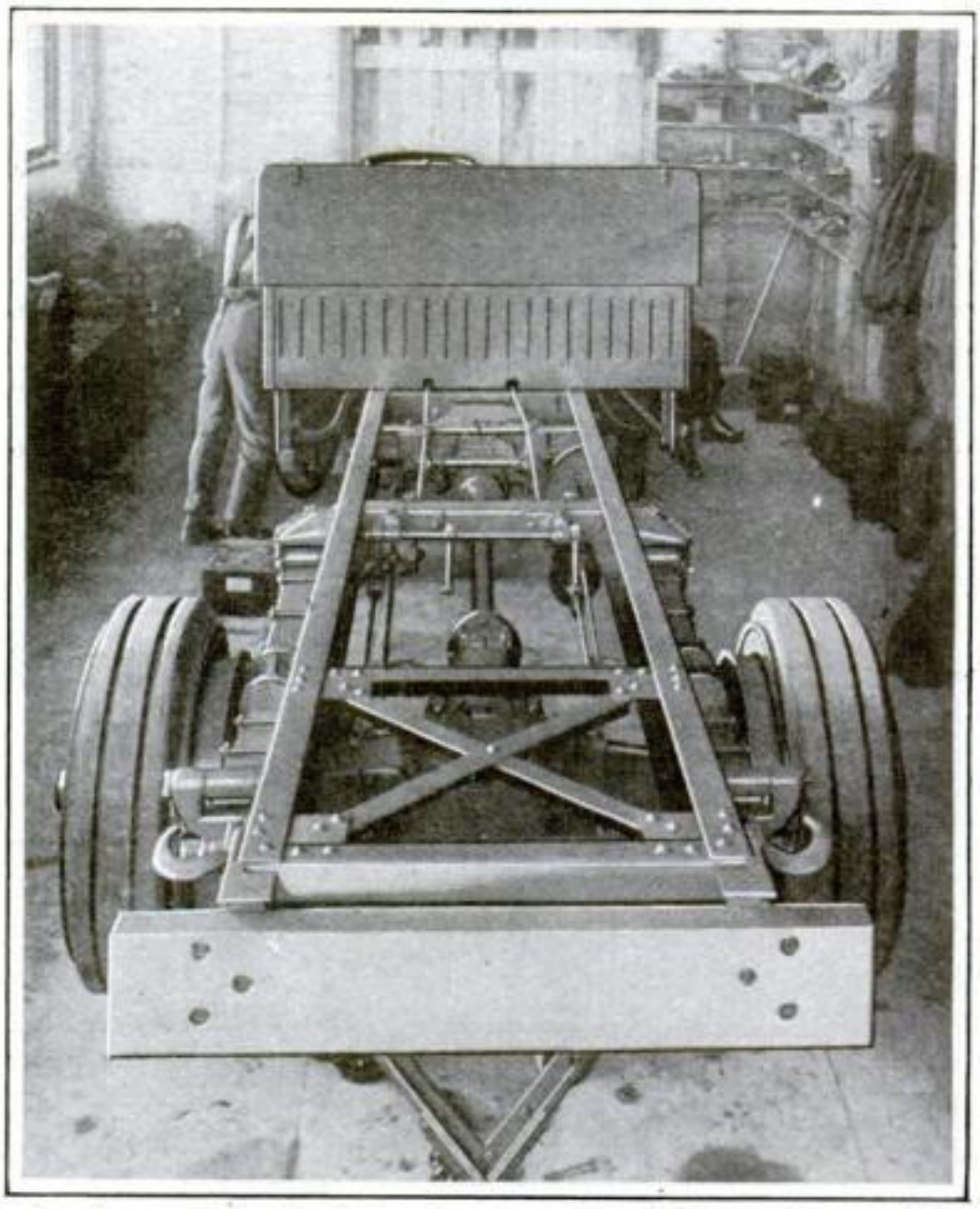




The Unique Gas-Saver

About three inches of the intake manifold is inside of the exhaust manifold, so that the low grades of fuel now used will be vaporized before entering the explosion chambers

covered. Following these tests, ten thousand of these trucks will be put together in a dozen or more plants before June 1 and shipped abroad in time to take their places behind the trenches with our armies, now in training. It will be simple to keep them in repair in France—simpler than any of the allied armies have found it with their trucks, burdened as the Allies are with several makes, each having its own peculiar characteristics and each requiring a separate supply of spare parts. This follows because our trucks are standardized. Now do you see what standardization means? There is nothing technical about it. It's just common sense—that's all. It simply means that every engine, every front axle, every rear axle, every change-speed mechanism or gearbox is interchangeable with every other similar part in every other truck. If the engine of one truck is shot away by a small shell and the chassis frame remains intact, no drilling, boring or other changes will be necessary in order to drop another engine in place and put the vehicle on the road at once. This standardization is carried down to every part of the entire vehicle, including such accessories as magnetos, carbureters, batteries, head lamps and fuel tanks. Even the various sizes of bolts and nuts have been reduced to a minimum, some being made a trifle stronger than necessary just so that the number to be carried is small.



In the standardized truck every part is interchangeable with a similar part in every other truck—front axle, rear axle, change-speed mechanism, gearbox and other parts, big and little. If the engine of one truck is entirely demolished and the chassis frame remains intact, another engine can easily be substituted without the necessity of any exhausting delays in making the new parts fit

The engine is fitted with two independent sets of ignition apparatus, one a battery unit and the other a magneto, so that if one gets out of repair, the gas can still be exploded in the cylinders by sparks from the other source. In brief, the truck is characterized by the ruggedness of its parts, the combination of the best ideas in its design and their mounting so as to be extremely accessible for repairs.

It is to be remembered that this truck is intended solely for the use of the Quartermaster Corps and that other standarized trucks are being built for the Ordnance Department, the Signal Corps, the Engineering forces and the Medical Corps.

The tests of the truck which have already been made have proved so satisfactory that late reports indicate that contracts will be let for its construction in large numbers without waiting for the more extensive trials.

The Heart Is an Astonishingly Powerful Pump

Your heart is a very busy organ. While you breathe once, it beats four times. At each beat it sends four pounds of blood through your veins and arteries. The weight of the circulating blood is twenty-nine pounds. When you run, your legs and the other parts of your body need more blood, so your heart must pump faster.

A Portable Dental Ambulance for Treating the Fighter's Teeth

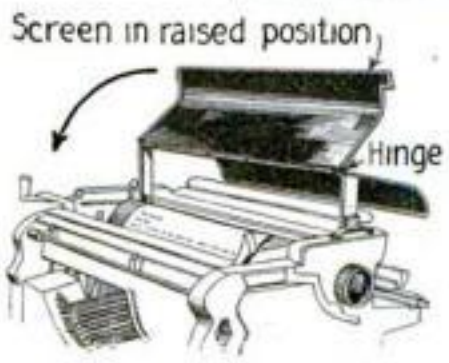
AT the beginning of the war, the dental surgeon, so far as the Allies were concerned, was not officially recognized in army circles. Indeed, it was not until the Germans marched into Brussels, with a dental post every ten kilometers, that the Allies appreciated the importance of oral hygiene.

To-day there are eleven American dental field ambulances in France alone. Men, who were formerly sent home on sick leave, whose only trouble was their molars, are now kept at the front. Soldiers, to the number of a division and a half have thus been spared to the army. Furthermore, the surgeons insist that a wounded man with bad teeth makes a slow recovery. And then, too, army rations are hard to masticate, so that the man with poor teeth "bolts" his food and loses strength and endurance. In our new National Army there will be a dentist for every five hundred men.

The accompanying illustration shows a portable dental ambulance used in several National Guard camps.

© Int. Film Serv.

Twenty per cent of the injuries the soldiers receive are face and head wounds, which require dental treatment as well as surgical attention



The protective metal screen permits the typist and no one else to see what she is writing

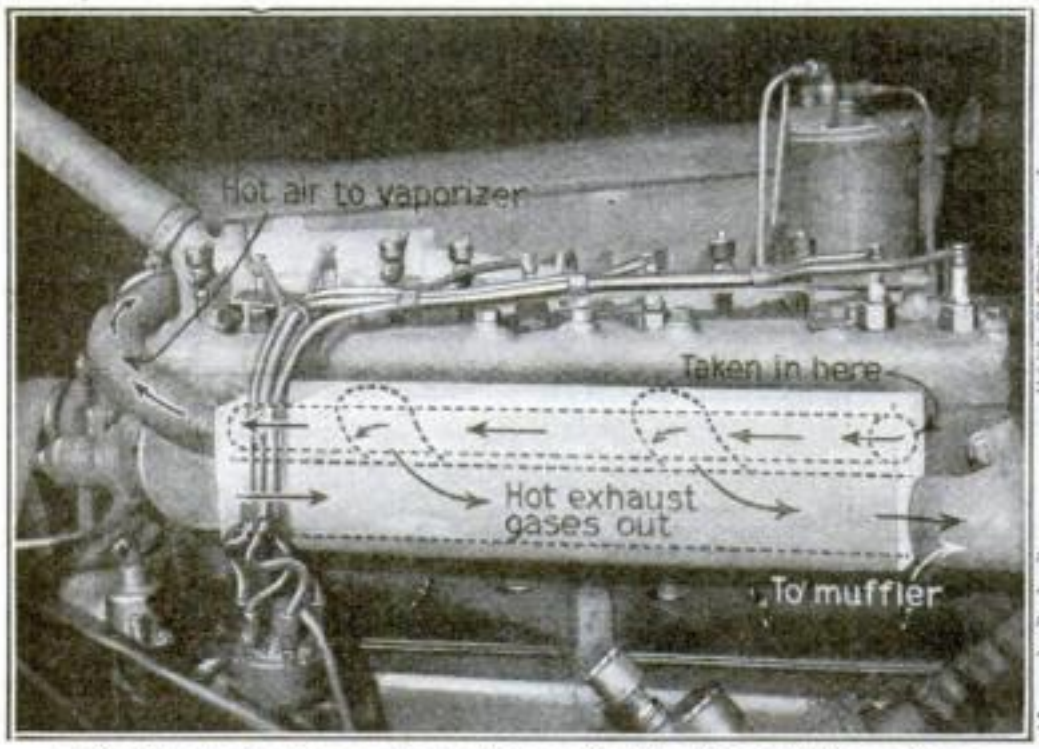
At the left the screen is shown raised. It can be adjusted to any make of typewriter

Foiling the Busy-Body with a Letter Screen

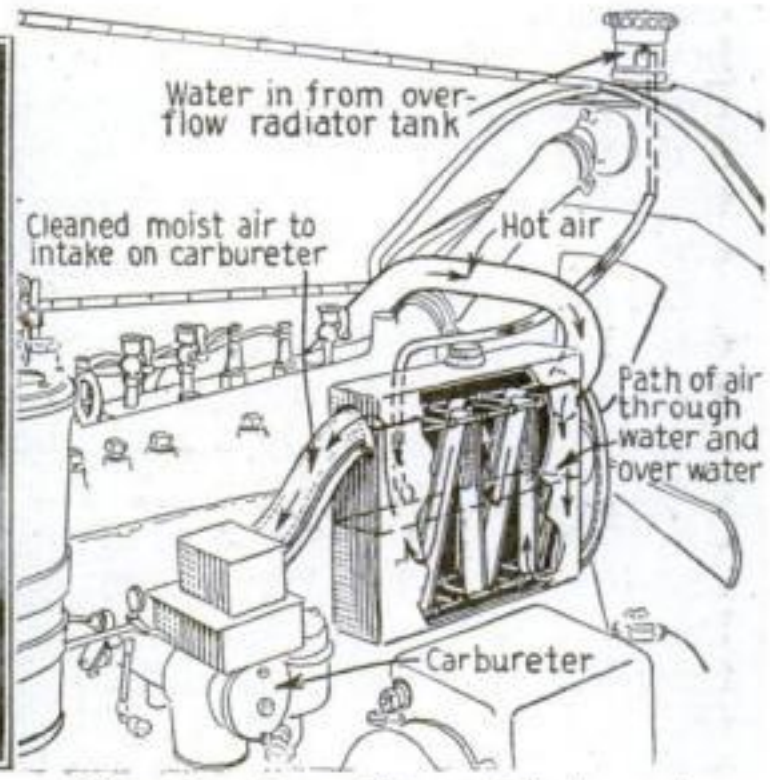
CURIOSITY often impels persons to read letters which have been left in the typewriter in a partly finished condition. Business secrets and information of a confidential nature are thus very often divulged. A simple and effective remedy is offered in a device patented by Henry R. Knowles, of Rudley Park, Pennsylvania. It consists of a metal screen, hinged through its center and fastened to the carriage of the machine. It is adjustable to any make of typewriter. By raising the forward part of the screen, the typist may read the letter or make corrections when necessary. When released, the screen will drop of its own weight and completely cover the letter in the machine, with the exception of the last two lines, which the typist can see from a sitting position. These lines can not be read by anyone standing behind or in front of the machine.

Washed Air for the Carbureter

An atmospheric stabilizer draws air from the exhaust manifold

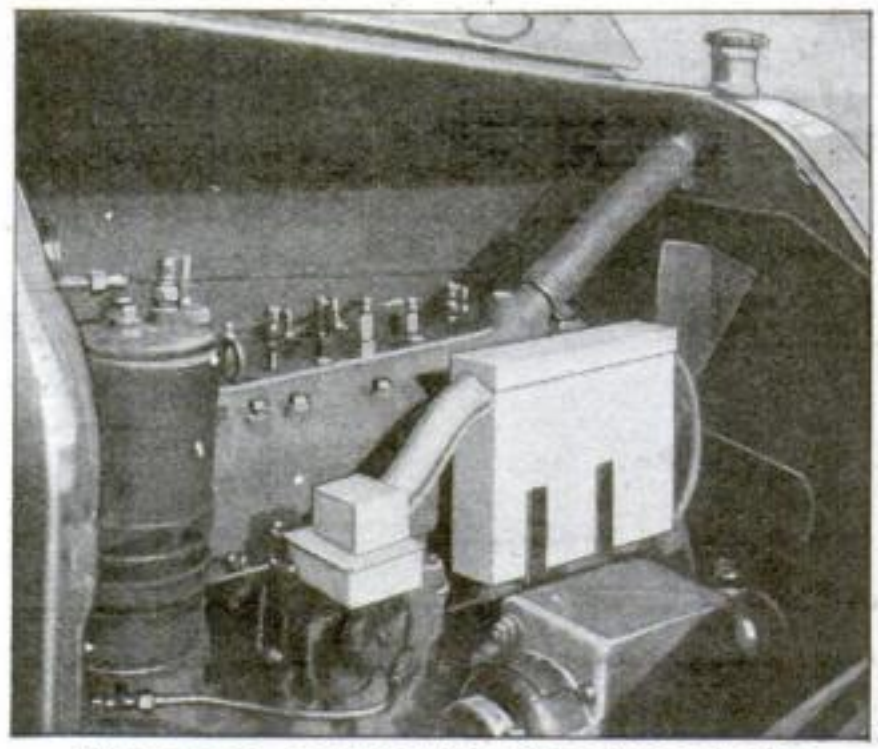


The hot air is carried through flexible tubing from the manifold surface to a dampener containing water and wicking, where it is thoroughly humidified



Showing how the water is automatically fed from the overflow of the radiator tank to the stabilizer

AUTOMOBILE drivers are well aware that the engine works more efficiently and more satisfactorily in the early morning and late evening when the humidity is high. Hence, it occurred to one inventor, to humidify the air as it is admitted to the carbureter and to do it whenever it was desirable. The atmospheric stabilizer, as the device is called, maintains the air at a uniform temperature, as it is drawn from (but not out of) the exhaust manifold, the hottest exposed part of the engine.



The space occupied by the atmospheric stabilizer is comparatively small

The hot air is conveyed through flexible tubing from the manifold surface to a dampener containing water and a wicking, which is automatically fed from the overflow of the radiator tank, as the accompanying drawing illustrates. Because of the arrangement of the wicking, the hot air must pass through water on the way to the dampener. This not only humidifies it, but also washes it free of dirt and grit.

The principal result of providing air properly humidified and at uniform temperature, is a smooth running, efficient engine. A secondary worthwhile result is a lessened consumption of gasoline.

Bullets Made of Paper Do More Damage Than Metal Ones

INCREDIBLE as it may seem, bullets made of paper will do much damage. A recent experiment has shown that a paper bullet, after having passed through six pieces of tin one foot apart, buckled them. A similar experiment made with metal bullets showed that they passed through the same thicknesses of tin but they made only a small clean-cut hole.

Taking the Staccato Bark Out of the Machine Gun

THE machine gun, properly hidden, makes its presence known only by a light blue vapor that is visible under certain conditions during firing, and by its noise, which is precisely that of the common pneumatic riveter used on structural steel buildings. At times the roar of firing, covers up this peculiar, harsh, regular, mechanical "Tat-tat-tat-tat"—but unless the firing is heavy the other side speedily recognizes the distinctive sound and looks for the gun. Can't the gun be silenced?

The most practical way of silencing firearms is to use Maxim's device, which consists of a steel cylinder larger than the barrel, attached to the muzzle of the gun. Inside the cylinder are steel disks set at a slight pitch, and with a hole pierced through them to permit the passage of the bullet. The gases, emerging under high pressure, expand into the silencer and are set to whirling, losing their momentum and much of their pressure and entering the air without causing a noise at the end of their whirling.

The noise of a gun, contrary to common belief, is not something within the barrel, but merely the violent slap of gases at high speed and pressure, impinging on the air at the muzzle. A silencer whirls these gases

While the Maxim silencer is entirely efficient, it is doubtful if it could be applied to the machine gun, because the firing of six hundred shots a minute would result in loading the cylinder with the gas from another charge before the first had escaped, and wrecking the silencer from the intense pressure.

The Italians are said to have machine guns that make merely a low, dull thud instead of the revealing crackle.

An American Fortune Spent for An English Invention

THAT there is just as great an opportunity for the inventor as there ever was, is vividly illustrated in the case of Frank Hornby, of Liverpool, England. Who has not seen the advertisements in nearly every American periodical of the mechanical toy, with which boys can build structures resembling bridges, buildings, derricks or ships? That toy is Hornby's invention—patented by him sixteen years ago and first thought of in 1899.

Hornby has a mechanical turn of mind. As a boy he was familiar with tools. It was for the two boys in his own family that he constructed the first early models of his toy. Finally, in 1901, he obtained his patent. There was nothing resembling it on the market. However, the trade did not enthuse over it. Hornby was working on a small salary in those days, and thus could not spend money for advertising. Fortunately, however, his employer became interested and assisted him in bringing the clever, new toy to the attention of the public.

Seven years after he obtained his patent, $40,000 had been expended in exploiting the toy. Still a market had not been created. But Hornby did not lose his enthusiasm. The next year, 1909, the toy came to America and thereafter Hornby came into the fortune that was rightly his. During the first year a business of $7,000 was done in this country alone. The following year it jumped to $24,000. In 1911 it climbed to $49,000 and in 1912 it touched $114,000.

Using Oil Instead of Gears

Hydraulic transmission does away with most of the present day gearing of automobiles

HYDRAULIC transmission for automobiles is not new. But the type of hydraulic transmission described here is both new and revolutionary. It has been simplified, and then simplified further, until it does away with the clutch, change-gear, differential and brake on the automobile. Moreover, as it is now applied to certain makes of motor trucks, it is performing the function of an ideal speed control.

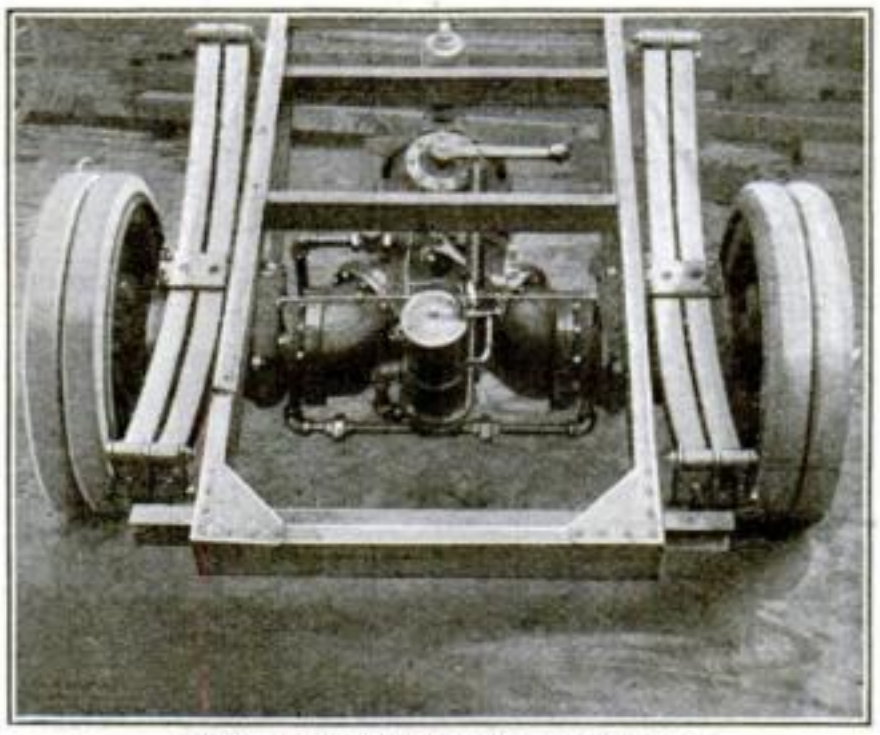
Among those who were instrumental in developing it, are the Chief Mechanician of the Navy, and two mechanical engineers, Charles R. Pratt and H. F. J. Porter. In its original form, this transmission is now used on many battleships of the different navies of the world. Because of its ability to impart a very large number of speeds, it has been found excellent for revolving turrets and for maneuvering guns which have to be trained upon an enemy's ship, dashing here and there over a zig-zag course.

The large number of speeds is obtained in this manner: The pump cylinders of the system are always driven around at the constant, full speed of the engine. The collar of the pump pistons is pivoted about the diameter and remains stationary. With the collar in the "dead" position, the pistons cannot reciprocate and no oil is pumped over to the hydraulic motors. But begin to tip this collar, and back and forth go the pistons, forcing streams of oil into the motors.

The more the collar is tipped, the greater is the amount of oil forced over. To take up this oil and to send it back again into the pump chambers, the pistons of the two motors start reciprocating. In other words, since the motor collars are stationary, the constant-stroke motor pistons start turning.

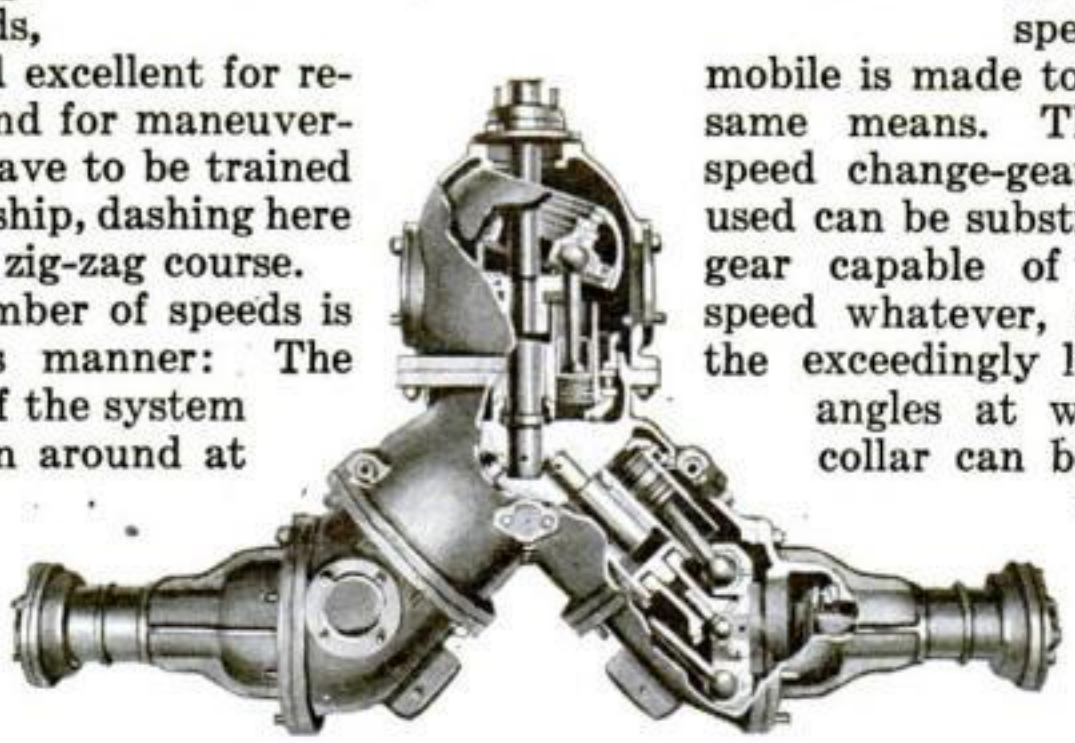
The motor cylinders that revolve are connected with the rear driving wheels. The rate at which the cylinders rotate depends upon the quantity of oil they handle in a given time. Since this quantity is increased by tipping the pump collar, it is obvious that the speed of the automobile is made to pick up by the same means. Thus, the three-speed change-gear now generally used can be substituted by a fluid gear capable of producing any speed whatever, depending upon the exceedingly large number of angles at which the pump collar can be tipped.

When turning a corner, the difference in the rotation speed of the rear wheels is taken care of by more oil going over into the motor connected with the outer wheel.



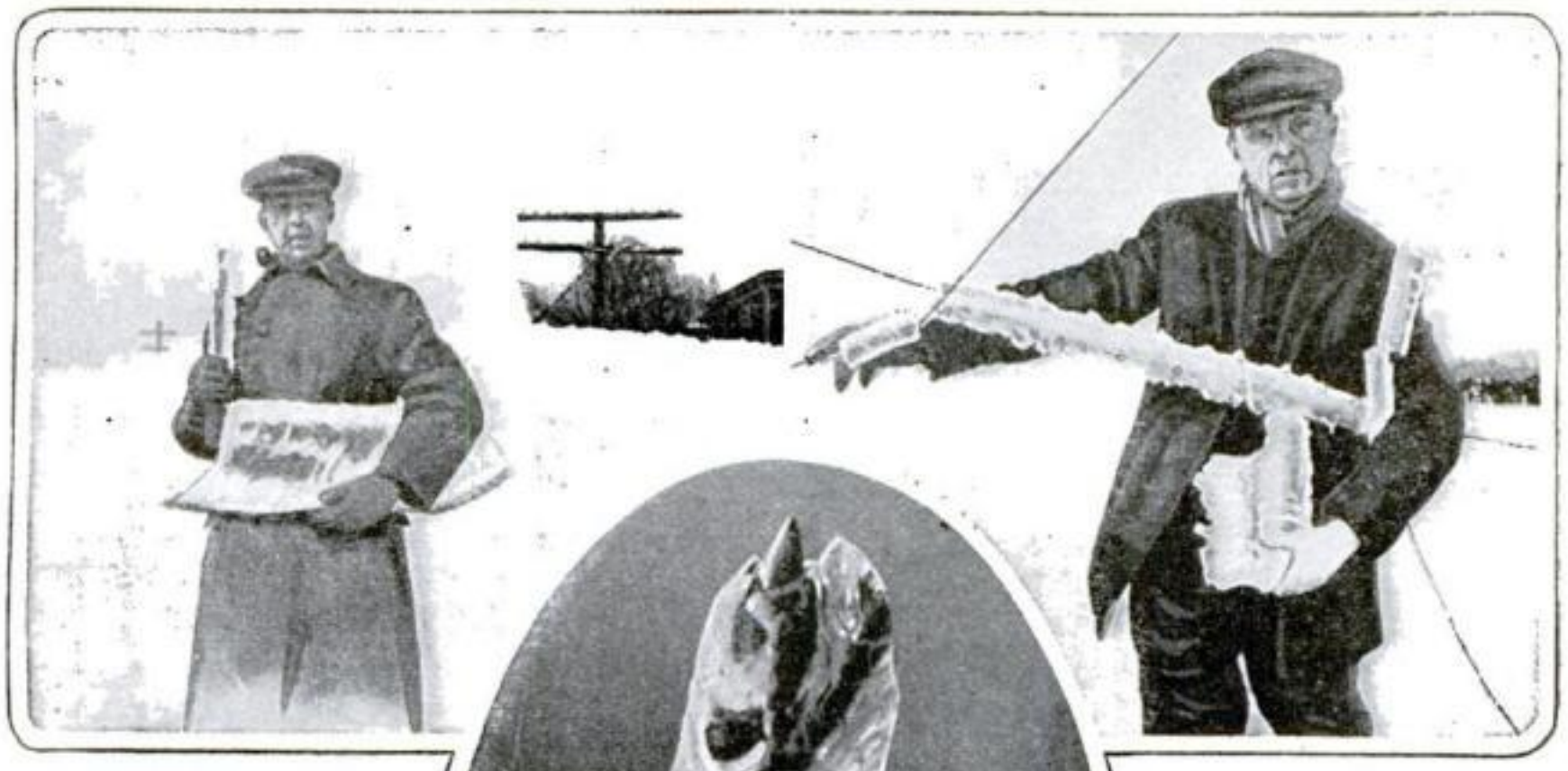
Why Gears Are Unnecessary

The oil between the hydraulic pump and the motors, being imcompressible, forms a rigid gearing which takes the place of the clutch, change-gear, differential and brake. To start, the driver throws over the controlling lever to full speed. The automobile gains speed gradually and without the slightest jerk. This is accomplished by an attachment which permits the pump collar to incline slowly as the automobile runs faster. Should the automobile be stopped abruptly, the collar is immediately brought back to its neutral position and the engine power is shut off automatically



Glaze: An Old Winter Foe with a New Name

Sleet storms will hereafter
be called glaze storms

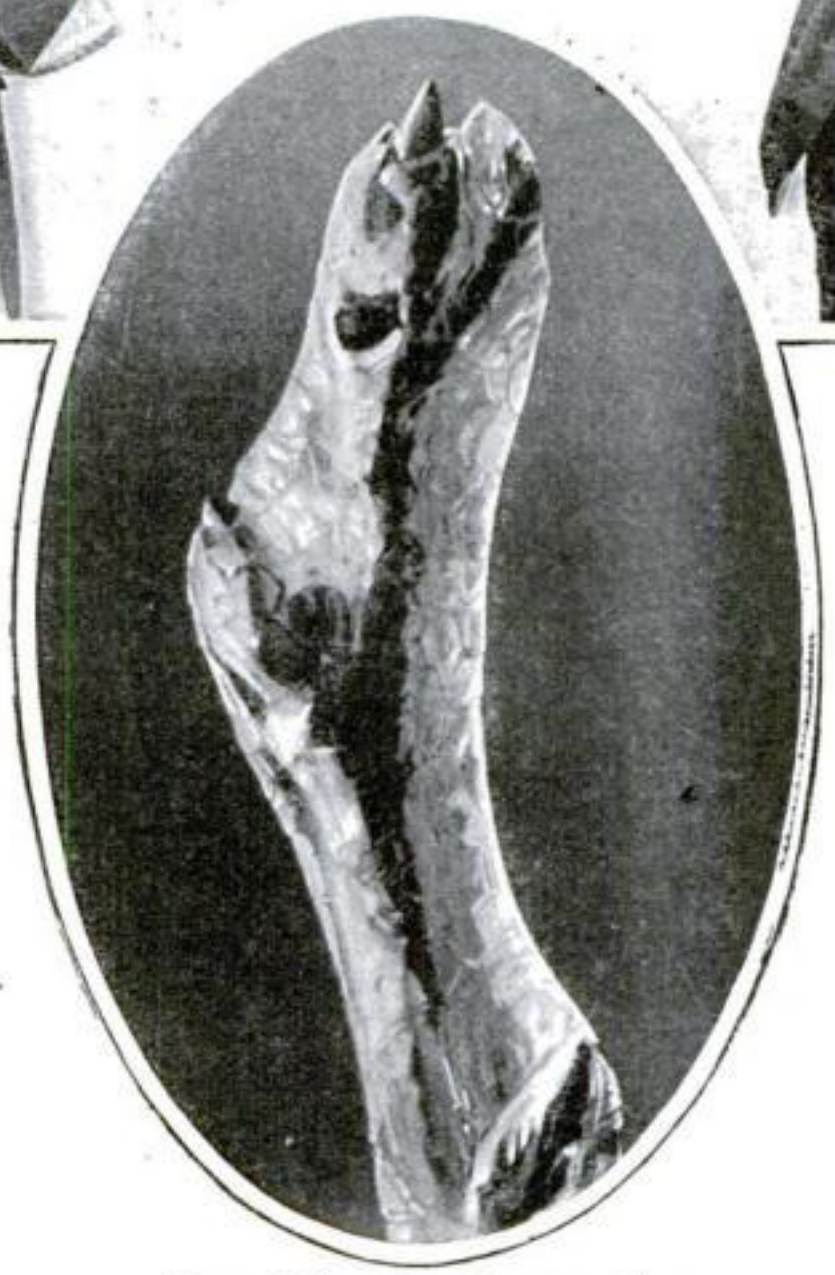


This is Glaze

It has been with us since the beginning of time, but it was only a year ago that it obtained its christening from the U. S. Weather Bureau

Heavy as Lead

Not only branches, but telegraph, telephone and electric wires break under the heavy load. The deposits reach remarkable dimensions



Beautiful—But Destructive

The branches of trees and shrubs become encased in glaze, until the whole landscape resembles fairyland

LAST winter a new weather word made its bow in the daily press —"glaze." Occurrences of "glaze" were frequently reported, and some of the visitations of this atmospheric phenomenon occasioned damage to the extent of thousands of dollars.

In previous years the newspapers called it "sleet" or "ice" or "silver thaw." Glaze forms when rain is turned to ice by the low temperature of the objects upon which it falls. Here are some results of actual measurements. A twig 3-16 inch in diameter has been found to measure with its ice coating nearly two inches in diameter. One case is reported in which an ice-coated elm twig about six inches long, broken from the tree, weighed 15½ ounces. This was about five hundred times the weight of the twig alone. The coating on a slender telephone wire may attain a thickness of two inches and upwards. Indeed, cases are recorded in which the combined thickness of ice and snow on such a wire reached the enormous diameter of ten inches. No wonder hundreds of miles of wire and thousands of poles sometimes go down when glaze occurs on an extensive scale.

But why "glaze"? This word was introduced by the Weather Bureau over a year ago, because a distinctive name was needed for these ice deposits. The electrical industries had fallen into the way of calling this formation "sleet." But "sleet" means something different—or rather several things. This word is applied by some people, especially in England, to falling snowflakes mingled with rain. Now it must give way to "glaze."

Making Millions Out of Bubbles

Huge profits, undreamed of yesterday, are now obtained from the dump pile of low-grade ores

By George Merriman Oaks

Managing Editor of the Popular Science Monthly

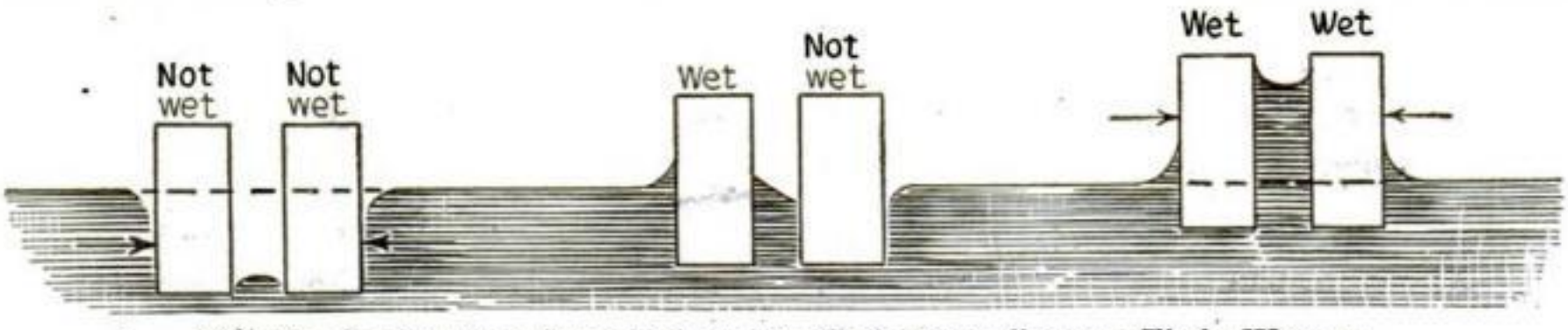
MILLIONS are at stake in lawsuits brought about by infringement of the froth flotation patents. Clearly, they must be very important patents. In truth, they are the basis of a great industrial achievement. In one mine alone the flotation method increased the daily output of zinc by 200,000 pounds; in another, the daily increase in copper was 120,000 pounds. The adoption of froth flotation by the five leading porphyry mines of the United States would mean a yearly saving of $17,000,000.

What is froth flotation? Nothing but the industrial utilization of bubbles. Who would believe that bubbles could be turned to money—yes, millions? And to think of applying such ethereal objects as bubbles, whose greatest achievement has always been to grow a little bigger and then burst, to an industry like mining!

Why Doesn't He Sink?

This water-spider floats, not because he is so light, but because of surface tension. With a little care, a needle can be floated in the same way

It seems as though Nature's most precious gifts are often hedged about with thorns so prickly that ceaseless labor is necessary to obtain them. We find copper combined with sulphur as copper sulphide. Furthermore, the sulphide is shaken up with all sorts of worthless mineral matter, such as sand and limestone, until it seems hopelessly hidden from man's reach. The same is true of the other base metals, zinc and lead. The useless matter



Floating Bodies Are Attracted or Repelled Depending on Their Wetness

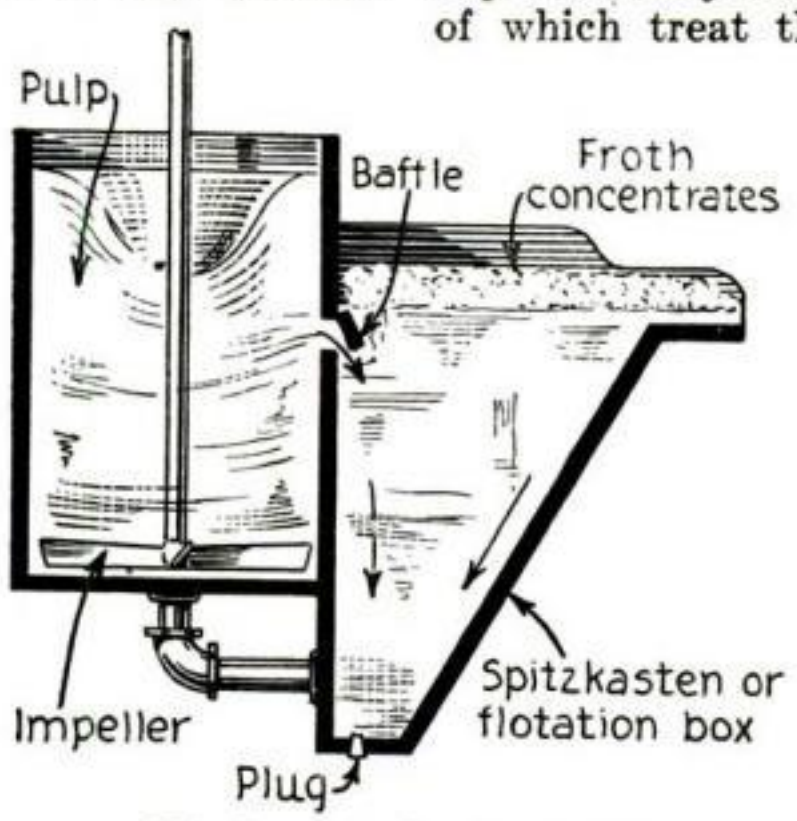
Attraction of two bodies not wet by a liquid. In this instance, the pressure is the same at all points indicated by the dotted line, namely, that of the outside atmosphere. Pressure is also that of the atmosphere in the air space between the two bodies; but the water pressure on each side (indicated by the arrows) is greater, pushing the two bodies toward each other. Applies to sulphides in water

Repulsion of two bodies, only one of which is wet by a liquid. Pressure on left side of wet body is less than that of atmosphere which acts on its right side, pushing it away from the other body. Pressure on left side of body not wet by liquid is greater (below surface of liquid) than that of atmosphere on right side. Hence the pressure of the liquid pushes the body not wet away from the other body

Attraction of two bodies wet by a liquid. Pressure is the same at all points indicated by dotted line, namely, that of the outside atmosphere. Pressure is less in the liquid between the bodies and above the dotted line. Therefore, the atmospheric pressure outside pushes the bodies toward each other. The liquid rises between the bodies due to the principle of capillary attraction

found in conjunction with the sulphides of lead, copper and zinc, is referred to as gangue. Concentration is any process of separating the valuable metal from the worthless gangue.

The simplest method of concentration is hand-shaking. We all remember our old American history which contained a picture of a flannel-shirted Forty-Niner "panning out" gold from one of California's rivers. He used an ordinary dish-pan, and by a careful shaking, slopped the water and gangue over the sides, the metal being allowed to settle.



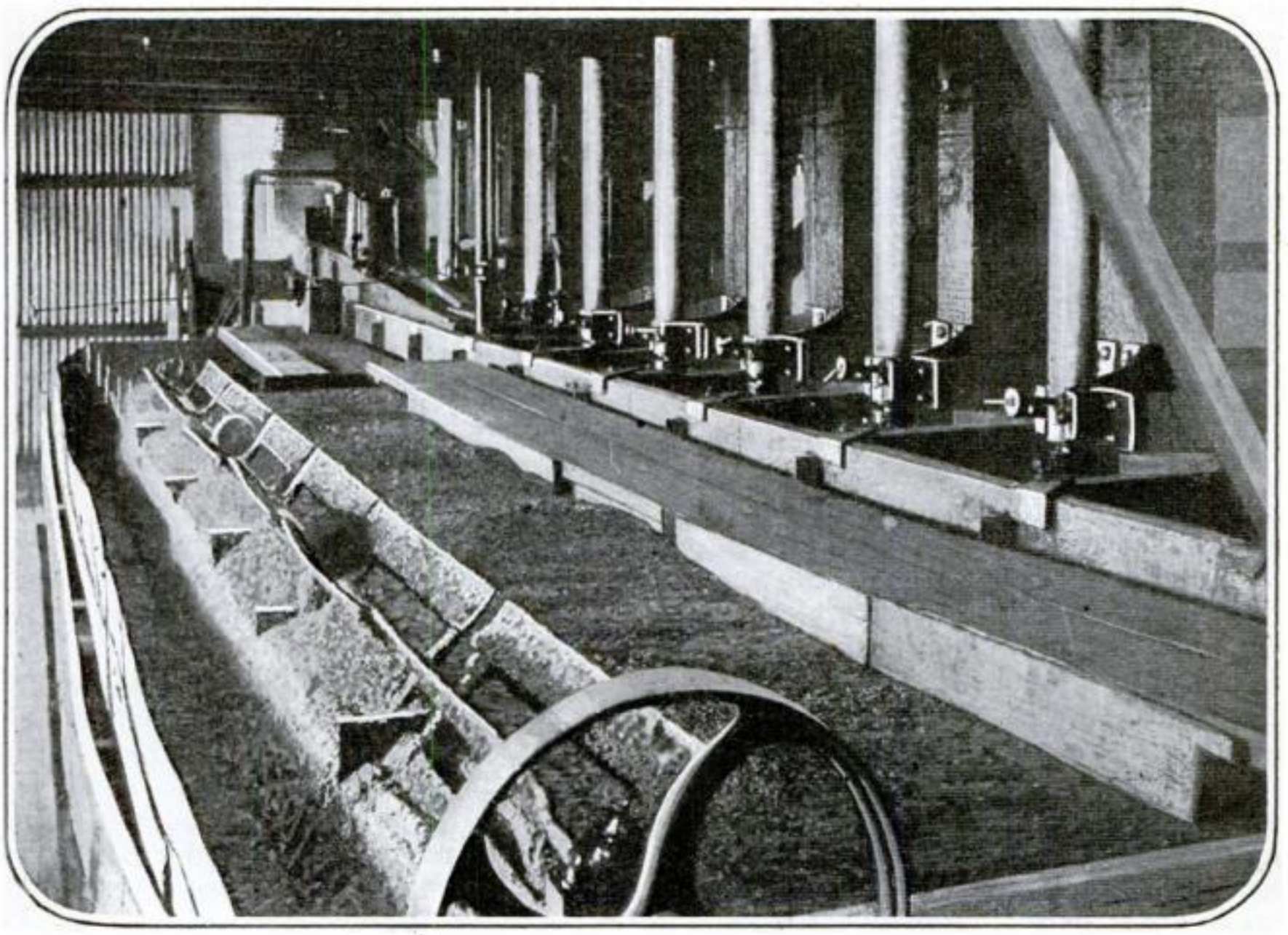
The Interior of a Single Cell

The pulp, consisting of sulphides, gangue, water and oil, is violently agitated by the impeller. From this chamber, it passes into the flotation box or spitzkasten. The froth, bearing the metal, is floated over the lip and the worthless gangue is then allowed to sink to the bottom

Various Methods of Concentration

Hand-shaking has long since been superseded by mechanical methods, some of which treat the ores wet, and some dry. Both take advantage of the difference in specific gravity of the gangue and of the metal. In the dry method, a current of air is used to blow away the lighter gangue, leaving the heavier minerals on a flat corrugated surface. In the wet methods, the ore passing through a stream of water separates into two parts, the metals sinking and the gangue being washed away.

But now comes a



The Metal-Laden Froth After Running the Gantlet of Agitation Cells

The feed passes through two agitation boxes before entering the spitzkasten where the first concentrate is removed by means of a paddle. The remaining pulp passes through a pipe to the third agitation box. From this the pulp passes to the second spitzkasten, and so on down through the machine to the fourteenth spitzkasten. Discharge from No. 14 leaves the machine as tailing (refuse ore)

process which practically reverses the long-used wet method of concentration. Instead of sinking the sulphides, they are induced to float and the gangue is allowed to sink. Flotation is the term applied to this revolutionary method.

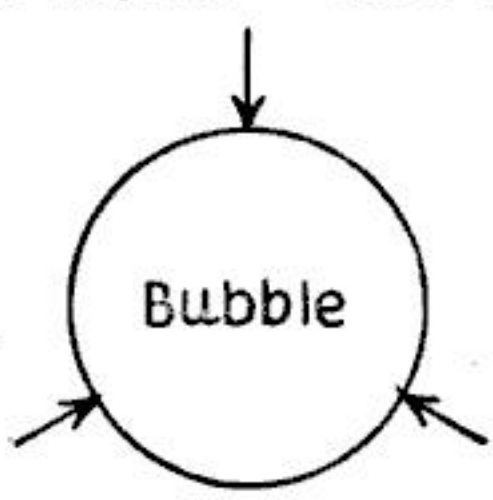
The history of flotation, like that of most great industrial processes, is not centered around any one man. Its development, though rapid, has involved a long list of patents taken out by a large number of American and foreign metallurgists.

The first patent which even suggested the process now known as flotation was obtained in 1860 by William Haynes. He knew that sulphides would stick to oil and in a crude way tried to use this principle in separating the metal from the gangue. He was followed by Bradford, whose method involved surface tension concerning which I shall speak later.

The Floating Spider

The underlying principles governing flotation are too theoretical to admit of satisfactory explanation. The how is more easily explained than the why. Have you never observed the trim little water spider go skating across a pool with the greatest ease and agility? And did you make the mistake of believing that he was floating simply because he is so light? Then try floating a needle on the surface of a glass of water. It can easily be accomplished and you will note that the much heavier needle seems to lie in a sort of depression in the surface of the water and does not readily become wet. This is due to surface tension, supposed to play an important role in flotation.

In surface tension we have a tendency on the part of a liquid to act somewhat like an elastic skin, trying always to contract to the minimum area. A drop of water does its best to shape itself into a neat little round sphere instead of spreading out over a large surface. But this is only on surfaces which water does not wet. In contact with paraffined paper, for instance, it maintains the drop form; on the other hand, it quickly sinks into the meshes of a piece of blotting paper. If a needle is perfectly clean, it will sink; if it is greasy, it can be made to float. The explanation involves two phenomena, surface tension and adhesion.



A Bubble Bursts by Crushing Itself

It is believed that surface tension acts like a rubber membrane over the bubble, constantly exerting an inward pressure which finally results in its collapse. That tension is reduced by the addition of a delicate film of oil or other viscous substance

Surface Tension Is a Force

Surface tension would at first give the impression that an actual film or skin were stretched over the surface of the liquid. In reality, the needle is supported by a force and not by the water itself. This is proved when the needle sinks—the water cannot hold it up.

There exists between the molecules of any body an attraction which holds them together. At the surface of a body of water, the top layer of molecules lacks an attraction from the outside. This lack is compensated by a greater attraction from below and from the sides. Thus a horizontal stretching is produced — called surface tension.

This force can be readily upset by bringing about an attraction from above so that the attraction of the top layer of molecules will be more nearly equal in all directions.

Now, water molecules are attracted by iron; consequently a clean needle becomes wet if brought into contact with the water. But water molecules are not attracted by grease; and so a greasy needle does not become wet—which means that a tiny film of air remains around the needle; and the molecules in the top layer of water are still attracted in a horizontal direction (surface tension) so that the needle cannot sink.

Sulphides are not readily wet by water. If crushed into finely divided particles, they tend to float because of surface tension. Gangue, on the other hand, is easily wet by water; consequently it sinks. This may be termed film flotation as distinguished from the newer and far more efficient bubble method known as froth flotation.

A Bubble Bursts by Crushing Itself

Consider the surface tension of a

bubble. Surface tension, as just described, applies to a level water surface. The surface of a quiet body of water is always level since the tendency is to reduce the area to a minimum. The same holds good in the case of rain drops and bubbles. A drop of water falling through the air becomes spherical since the sphere is the figure of least surface for a given volume. A bubble also assumes the spherical form for the same reason.

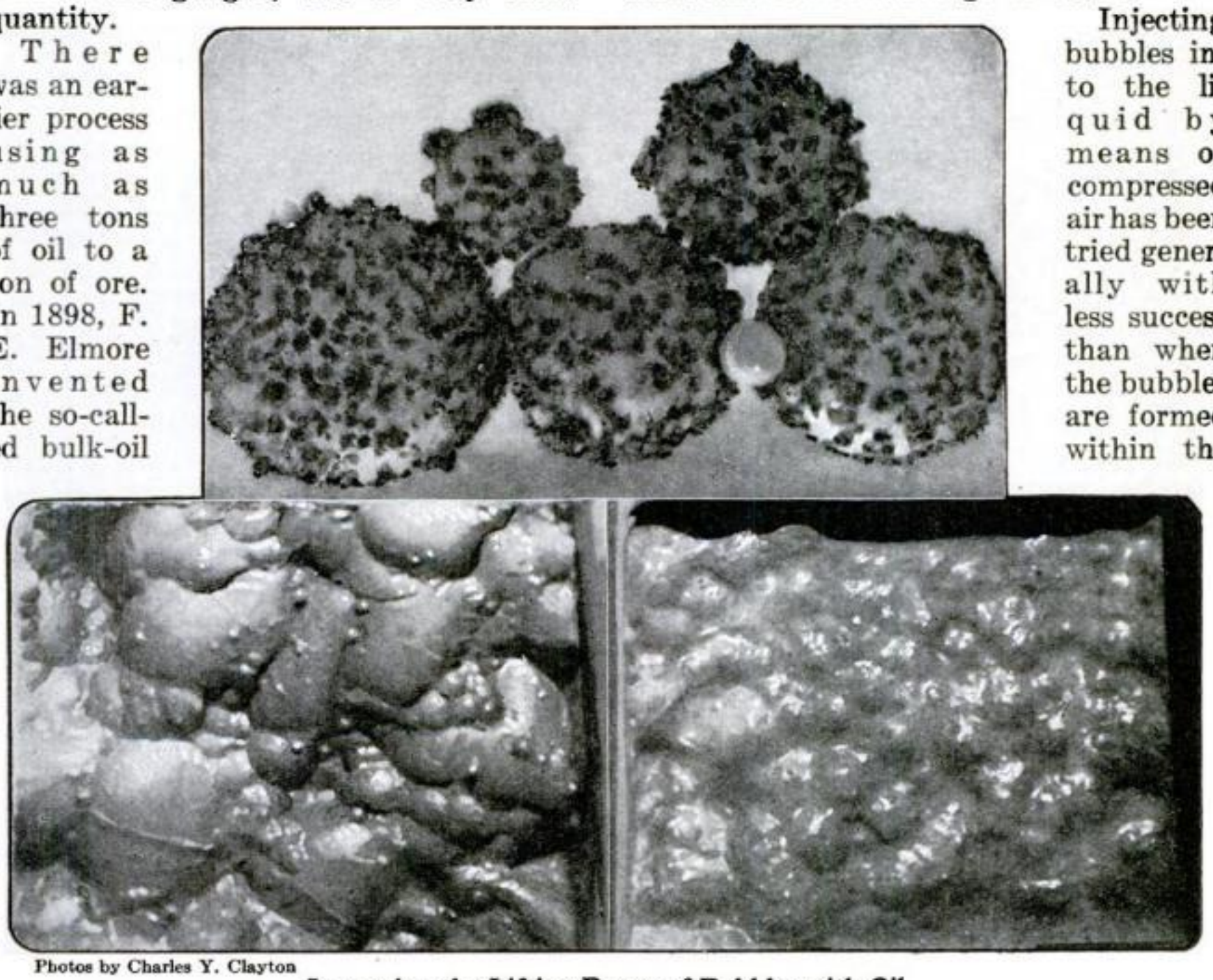
It would at first seem that some interior force causes the bubble to burst or explode. This is not so, if the prevailing theories are correct. It is believed that the surface tension acts like a rubber skin over a bubble, constantly exerting an inward pressure which finally results in the collapse of the bubble. If now we reduce this tension, the bubble will exist much longer. For this purpose, oil is added to the water containing the sulphides and gangue, but in very small quantity.

There was an earlier process using as much as three tons of oil to a ton of ore. In 1898, F. E. Elmore invented the so-called bulk-oil process. Strictly speaking, it was not a flotative process at all, the object being to recover the sulphides by using a very large quantity of heavy oil. The buoyancy of the oil was the sole agent in floating the metals. Sulphides, being wetted by sufficient oil to overcome the effect of specific gravity, traveled upward into the oil layer, and were consequently floated.

How the Army of Bubbles Work

In the froth flotation process only the faintest trace of oil is used. Briefly, the ore pulp, consisting of finely-ground ore particles suspended in a large quantity of water, is brought into contact with a minute quantity of oil. Through agitation, countless tiny bubbles are formed which carry the mineral particles to the surface with them, forming a dense froth several inches in thickness. The gangue sinks and is allowed to go to waste.

Injecting bubbles into the liquid by means of compressed air has been tried generally with less success than when the bubbles are formed within the

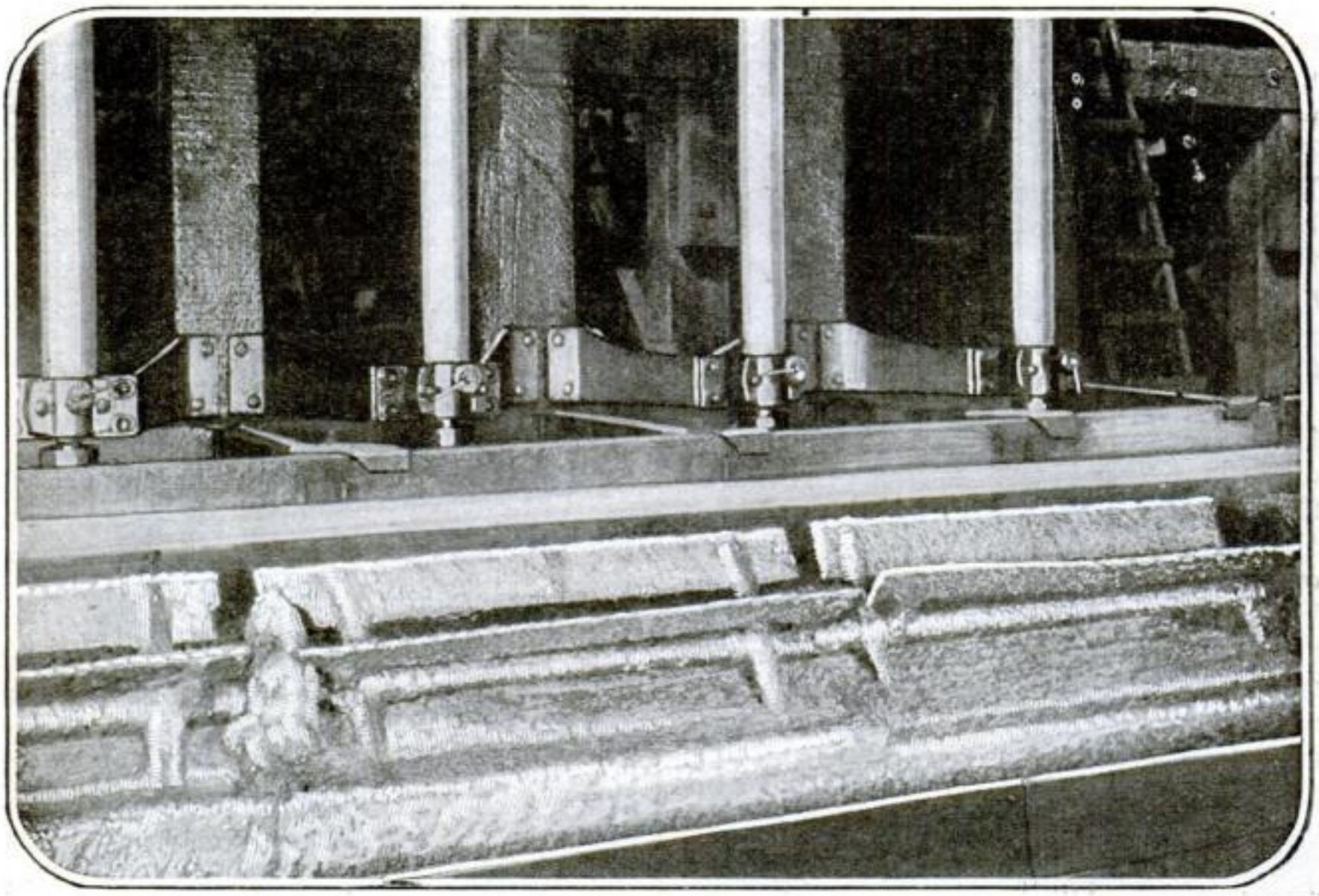


Photos by Charles Y. Clayton

Increasing the Lifting Power of Bubbles with Oil

At left: Cresylic acid froth. In this case the agitator has been stopped and the bubbles are beginning to coalesce. They are large and thin-filmed. At right is shown a pine oil froth, which usually has small bubbles. After the impeller has ceased its action, the froth coalesces into a scum

Above are shown bubbles of pine oil froth, to which are adhering particles of cassiterite (the oxide of tin). Pine oil is one of the best oils for flotation purposes, but it is costly. The creosotes, crude petroleum, and the coal tar oils have favor, sometimes with the addition of a small amount of pine oil



Froth Flotation Saves Vast Quantities of Base Metals Formerly Wasted

Myriads of glistening, dancing bubbles come surging along the surface of the liquid, crowding each other in their effort to reach the top with their precious cargo of mineral wealth. When Sulman, Pickard and Ballot discovered the froth process now in use, there was at Broken Hill, Australia, a 12,000,000-ton hill of ore which could not be recovered by ordinary methods. This ore was saved. When this issue reaches you, approximately 40,000,000 tons will have been treated since January 1917

liquid itself by violent stirring. The effectiveness of the two methods depends upon the physical characteristics of the ore.

Even when the mineral-laden bubbles reach the surface and burst, the metal particles are not allowed to sink because the bubbles directly underneath continue to buoy them up.

The floating of sulphides is greatly assisted by adsorption, which may be briefly defined as the tendency of gases or dissolved substances to cling to the surfaces of solid bodies. This results in a relatively high concentration of the gas or solution at the place of contact. The tiny particles of gas attach themselves to the solid particles, like barnacles to the hull of a boat. This film of gas surrounding the ore particles does not, of itself, possess sufficient buoyancy to raise the heavy mineral. But when it coalesces, or combines, with a few of the surrounding bubbles, the weight of the mineral is more than offset by the lifting power of the bubbles, and it comes to the surface. In this way, the bubbles "lay to" and together boost an ore particle to the top.

Carrie Everson's Contribution

Adsorption was first applied by Carrie Everson, who is regarded as the mother of ore flotation, though she never received any material reward for her discoveries. She added the use of acid to the processes already developed by her predecessors. In her process, the acid, by combining with the metal, was thought to liberate gas which attacked the ore particles and buoyed them up. As a matter of fact, the acid gives the sulphides a clear surface to which the oil will adhere. When left standing, the ores often become oxidized and thus hinder the action of oil in concentration.

For years, a story has been told of the accidental discovery of flotation. A Miss Carrie Everson, a sister of an assayer located in Denver, while washing some dirty sacks, in which concentrate had been sent to her brother, realized that the grease and ore particles floated on the water,

and subsequently patented her discovery. So the story ran. Romantic, indeed—but, like many another tale of the beginning of some great enterprise, it lacked the verification of fact. In reality, Mrs. Everson was the wife of a doctor. She was a good chemist and her discoveries were the result of laborious experimentation.

Potter and Delprat, though working independently, devised a method also involving the use of gas in adsorption. During the next few years, the names of Froment, Cattermole, Wolf, Elmore, De Bavay, McQuiston and Bradford came into prominence through their efforts in improving upon the earlier methods of ore concentration by flotation.

But not until Sulman, Pickard and Ballot had conjointly rubbed the miner's lamp which evolved modern froth flotation, did the colossal outlines of this djinn of mining appear in its true significance.

These men were experimenting with the Cattermole process which used oil in the proportion of from forty to one hundred and twenty pounds per ton of ore. The oily metallic particles collected in clusters and then sank from sheer weight. The gangue was forced upward by streams of water and floated off. These men decided to see what would happen if the quantity of oil was reduced gradually to the vanishing point.

As the percentage of oil was diminished, the results became less and less satisfactory, until the process failed to work at all. Then to the amazement of the experimenters, upon stopping the agitation, myriads of glistening, dancing bubbles came surging along the surface of the liquid, crowding each other in their effort to reach the top with their precious cargo of mineral wealth. The oil had entirely disappeared from sight and touch. Investigation revealed the presence of the oil on the metal particles in a very thin film. The bubbles were extremely small and persisted longer.

At Broken Hill, Australia, where the experiments were performed under the supervision of Sulman, Pickard and Ballot, there had accumulated about 12,000,000 tons of ore from which the metals could not be recovered by the ordinary methods. The weight of gangue equalled that of the zinc and lead minerals present. Therefore, separation by gravitation methods was out of the question. While the Cattermole process would recover a reasonably large percentage of these metals, the newly discovered froth method gave unlooked-for success, and has been widely used ever since.

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Is the Wind Right for Gas? Look At the Trench Weather Vane

THERE are weather vanes galore in the trenches and throughout the fighting area. Many of them are ornamental in design and plainly testify to the skilful fingers and artistic temperament of some of the boys. The one shown in the accompanying illustration was made by a Canadian soldier out of odds and ends of metal. It represents a cyclist and answers to the slightest breath of wind.

It is vitally important that the soldier know in what direction the wind is blowing or is likely to blow; for if it is coming from over the enemy's camp there is danger of a gas attack, and when the gas starts over, he has only from twenty to forty seconds in which to adjust his gas mask.

A weather vane made from bits of metal by a soldier at the front

The Stormy Weather Hat—It Protects the Ears and Neck

EAR muffs are clumsy, and for this reason they have always been unpopular, even among those compelled by their outdoor occupation to wear them in bitter weather. So Henry Vaughan, of Montreal, Canada, has invented a hat with a soft woolen flap attached to the sweatband. This does away with the necessity for the ear muffs.

The flap is shaped to fit the neck and to cover the ears

The woolen flap fits up into the crown of the hat when not in use; but when the wind is blowing a gale or when the snow flies, the wearer of the hat pulls down the flap and tucks it into his upturned coat-collar.

Yesterday, Invincible—Today, Useless

ARMORED automobiles and motorcycle machine-guns are following closely upon the heels of cavalry in the present war; they are speedily going into disuse. There was a time when much was expected from these swift-darting steel forts, for theory had indicated that no infantry would be capable of stopping their advance. Could not these cars break through the enemy's lines on the open field and through the enemy's advance guard while reconnoitering? An interesting question—but the amount of real open field fighting and of land reconnoitering in this war has been practically nil. The important fighting has taken place not on the smooth ground, but on ground chopped up with networks of deep trenches. Since ordinary automobiles and motorcycles could hardly charge across these lands, no additional equipment of this kind will be made for the United States Army. During Pershing's campaign in Mexico, the motorcycle played an important part as a trustworthy vehicle for despatch riders. In addition to this duty, however, there were several motorcycles equipped with machine guns. Plans to organize a company of motorcycle machine gun operators were never carried out.

One Movement, and Up Goes This Sturdy, Collapsible Ironing Board

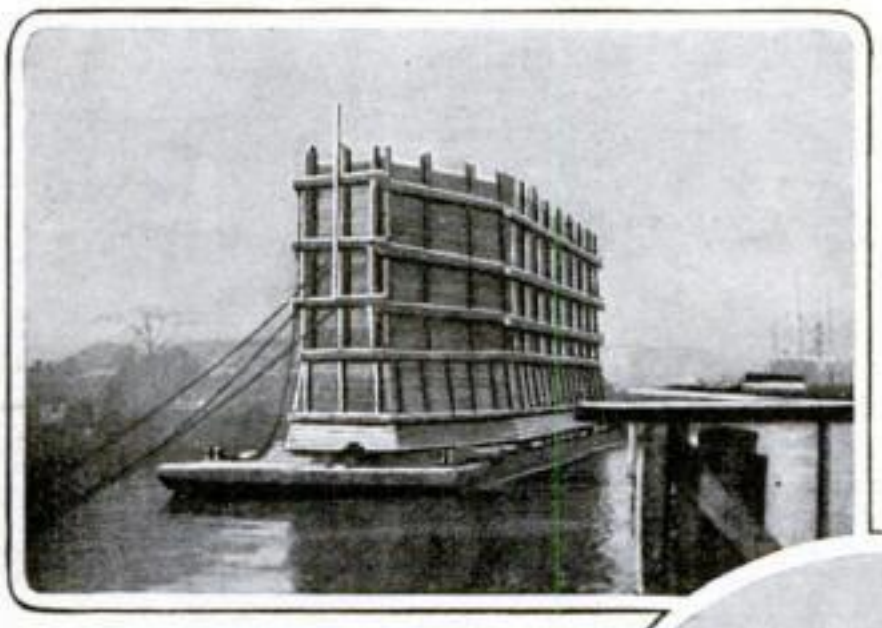
A SINGLE action suffices to set up or to fold a new type of ironing board, all parts of which are securely screwed or hinged together so that they cannot become separated. In setting up the board, the hinged central support is swung downward, requiring but one movement of the hand. Although the board is light and folds up compactly, it is firm and rigid when in use. A size smaller than that illustrated is made to fit into the modern housewife's kitchenette. When not in use the board may be hung up on a hook, the flat end first. This is done so as to prevent the supports from falling down.

It looks bulky but it collapses after the manner of a folding bed

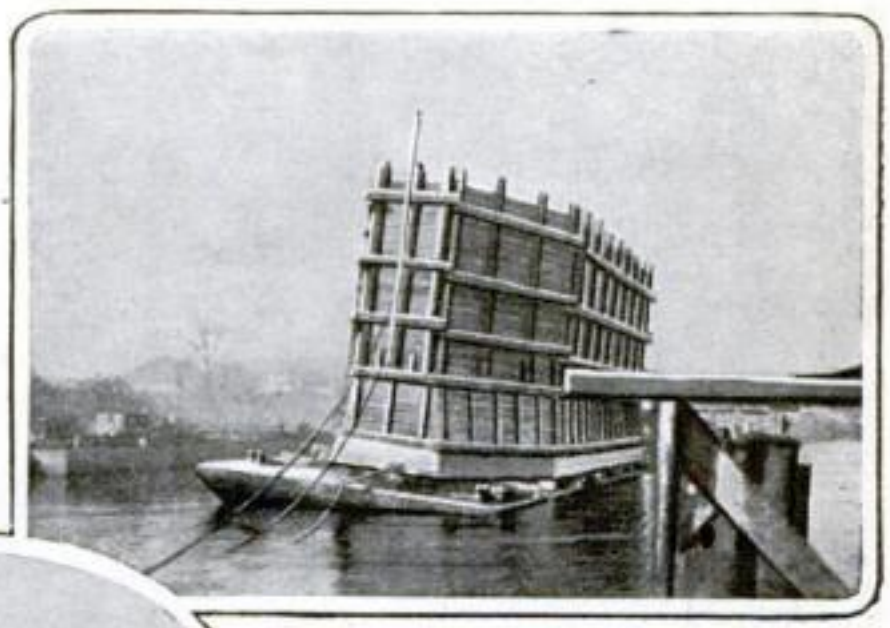
One movement suffices to set it up, ready for use

Launching a Bridge-Pier Caisson

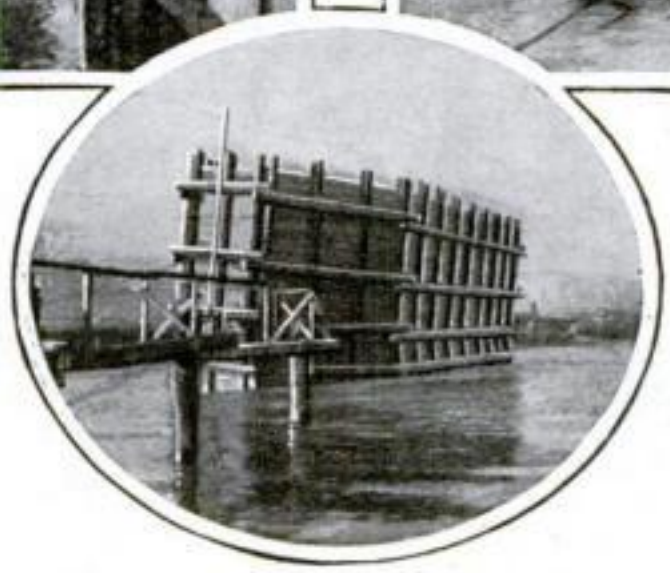
The caisson was built on a scow, on which it was towed to position and from which it slid into the water



The caisson ready to be towed out to its final resting place as a support for one of the concrete piers of the bridge



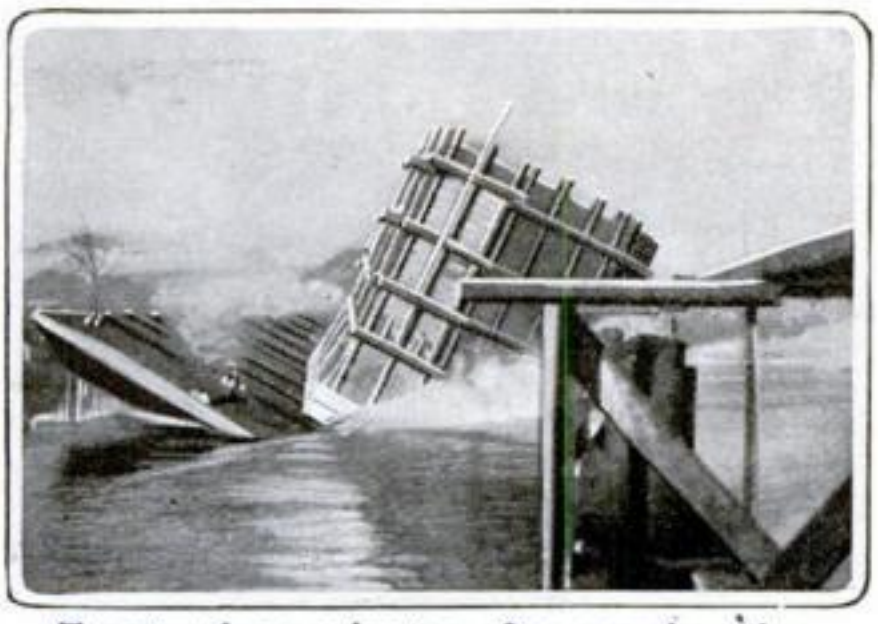
The only lines necessary were those to keep the caisson from floating down-stream and the towing lines



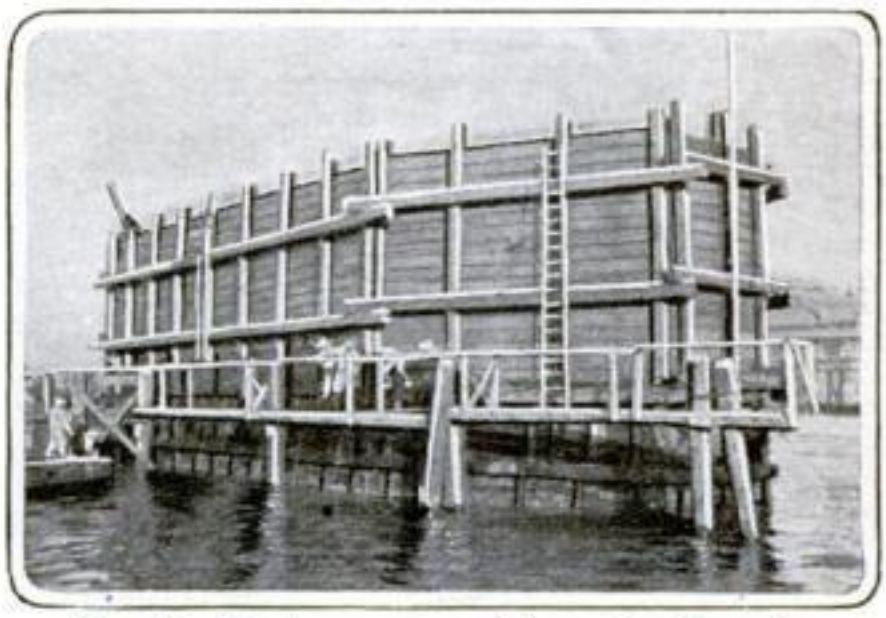
The scow was divided by a bulkhead so that water could be admitted into one side to make the scow list as the caisson slid off

AN interesting engineering feat was performed recently at Manila, P. I., when a timber caisson for one of the concrete piers of the Jones bridge was launched in half an hour.

The caisson was built on a scow which could be tilted so the caisson could slide off into the water and be towed to its location where it was to be sunk and the concrete pier built inside of it. The caisson was 100 feet long, 35 feet wide and 36 feet high, longer and wider than an ordinary city house. Three feet above the lower edge of the caisson was a 4-inch calked plank floor supported by inverted timber trusses, which in turn rested on timber sills bolted to the upper edge of the concrete walls. The floor and trusses were designed to withstand water pressure during flotation. When all was ready, the valves on the midstream side of the scow were opened. When the caisson began to slide, the scow was pushed from underneath the structure. It was manned at once and sunk by opening valves in the eight compartments into which it was divided.

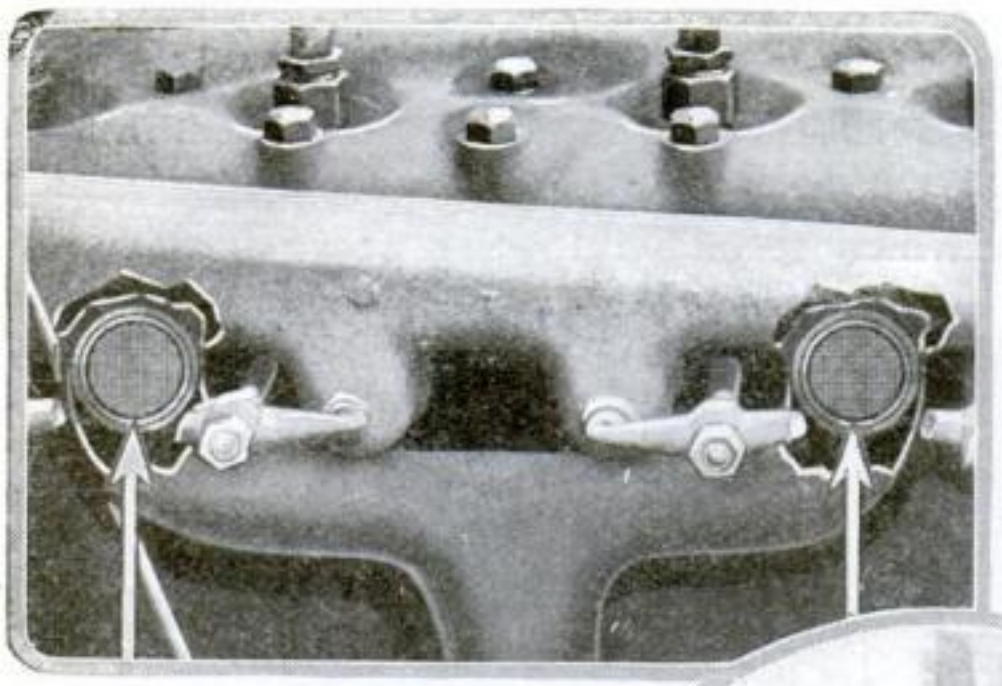


Twenty-three minutes after opening the valves, the list was fifteen degrees and the caisson slid into the water



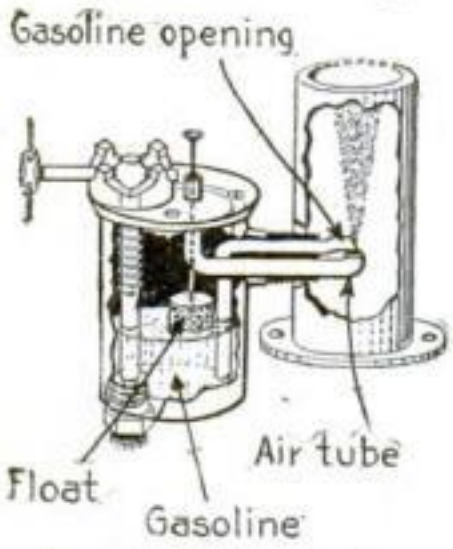
Due to the low center of gravity the caisson righted itself quickly and finally rested on an even keel in eight feet of water

Equip Your Automobile with the New Access-

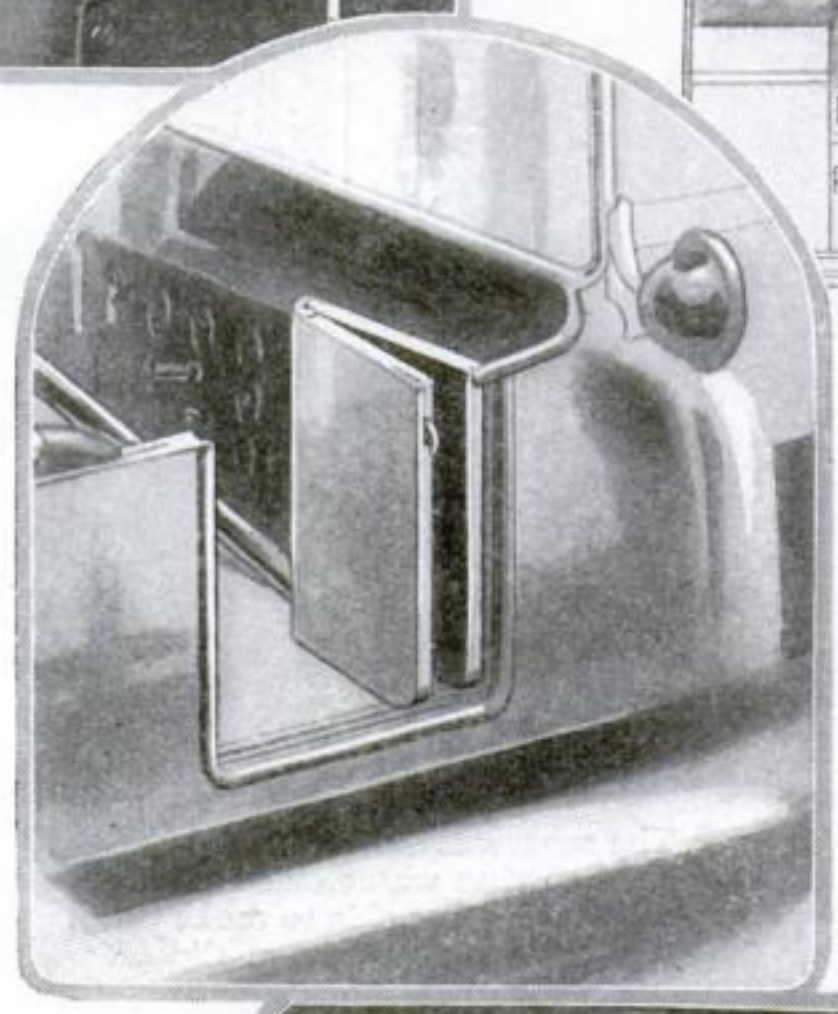


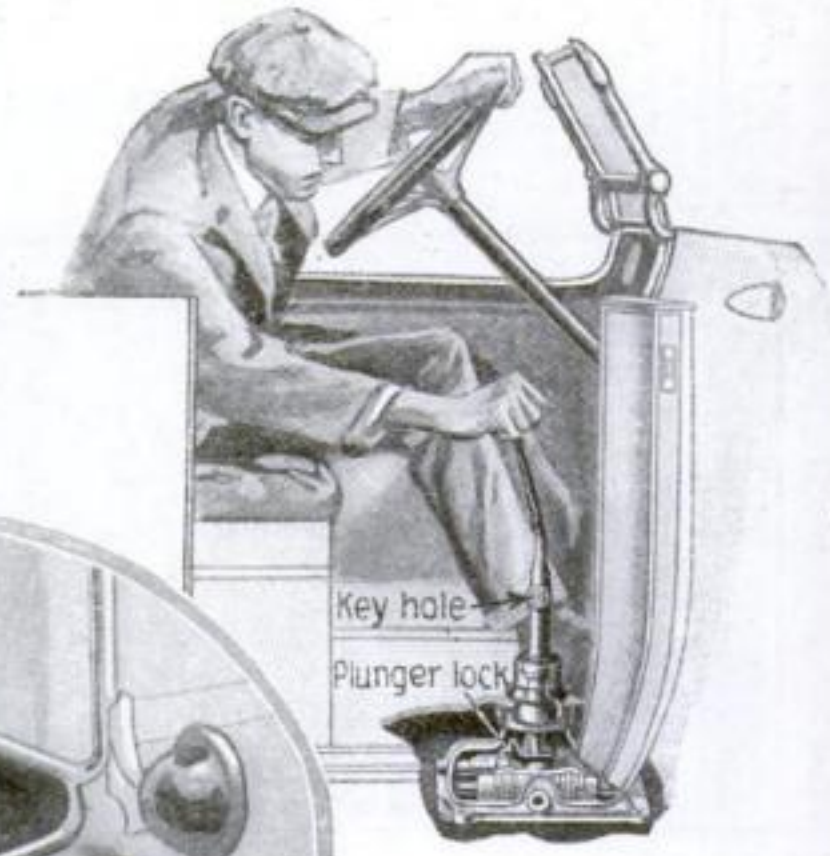
Wire screens inserted as gaskets between the intake manifold and the cylinders act as gas engine fuel savers. Complete vaporization is thus secured

A folding automobile door is said to have many advantages over the old style. When it is closed the folding door is as safe as any

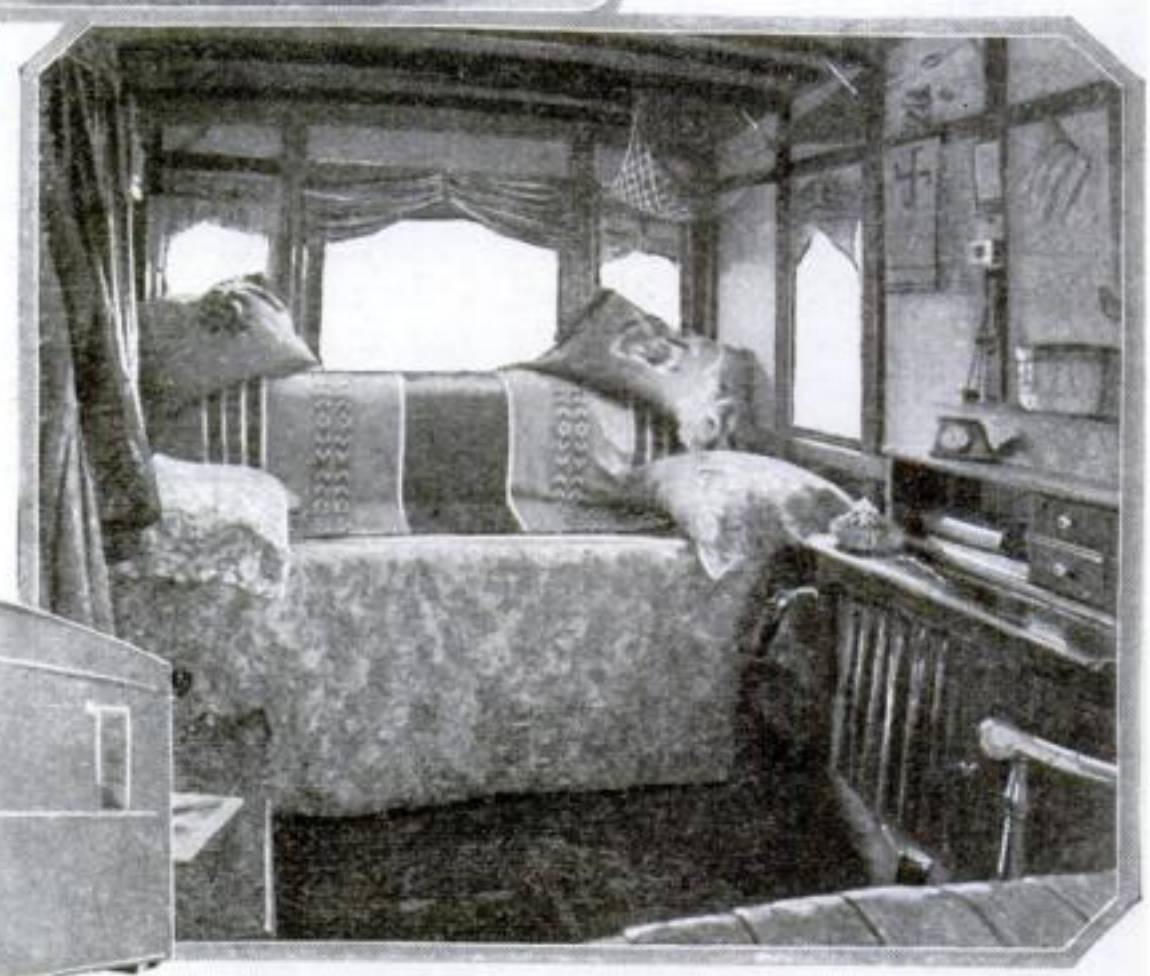


An atomizing carburetor primer to make the engine start easily. Air breaks up the liquid fuel





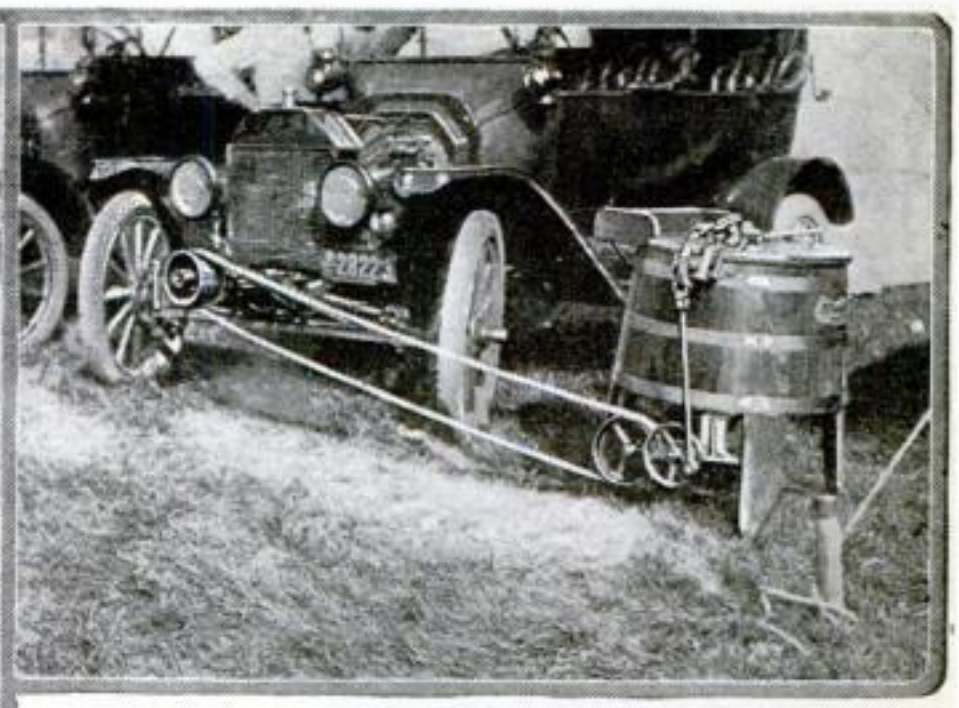
A safety lock which locks the shifter rods on top of the transmission case so that the gears can not be thrown into mesh and the car started without the owner's orders. Note the location of the key hole. The lock can be made to fit any of the modern clutch systems



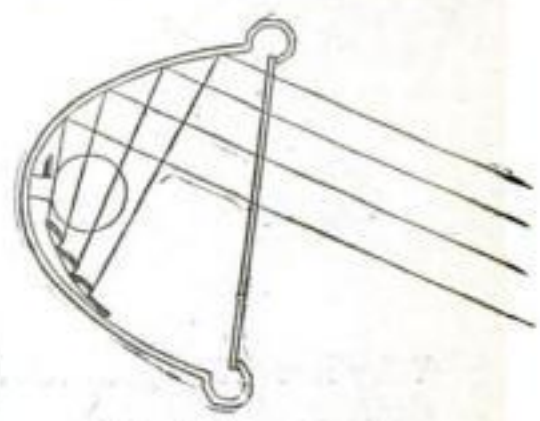
A bungalow on wheels, with all the comforts of home. It cost less than $200. The body is of light wood, covered with canvas. The interior is like a diminutive summer cottage

ories and It Will Do Almost Anything for You

A windshield with apron for tne motorcycle, affords complete protection for the driver and prevents any back-draft. The shield can be easily disconnected, yet it will stand the most violent vibration without breaking from its fastenings

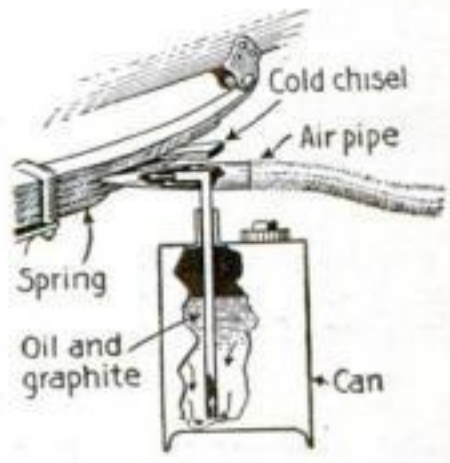


Operating a washing machine by applying a crank and pulley to the crankshaft. It only takes a moment to attach them



At left and above is a slotted fan-shaped headlight glare dimmer. The light rays are thrown to the top of the reflector and then deflected downward and out

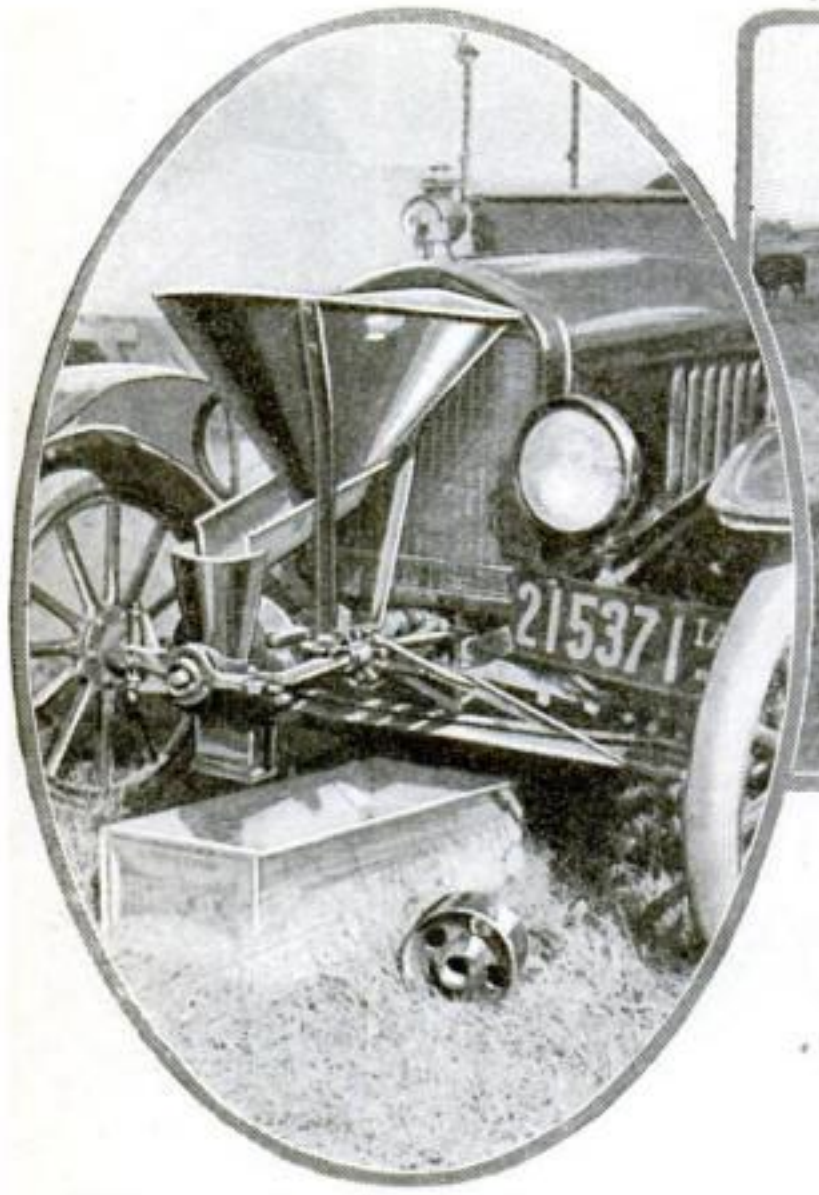
The unusual body, shown above, carries all equipment necessary to repair damaged or wrecked automobiles quickly on the road



Lubricating springs by forcing oil between the leaves under air pressure

The giant army truck, at right, has two radiators, steepled one above the other, to enable it to run loaded in hot weather

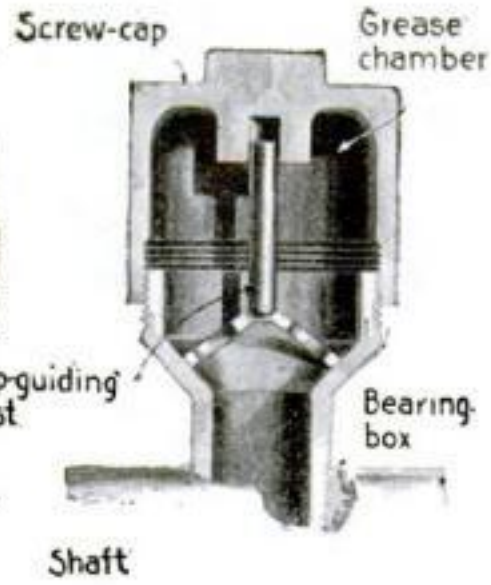
The Latest Appliances Which Will Help Put



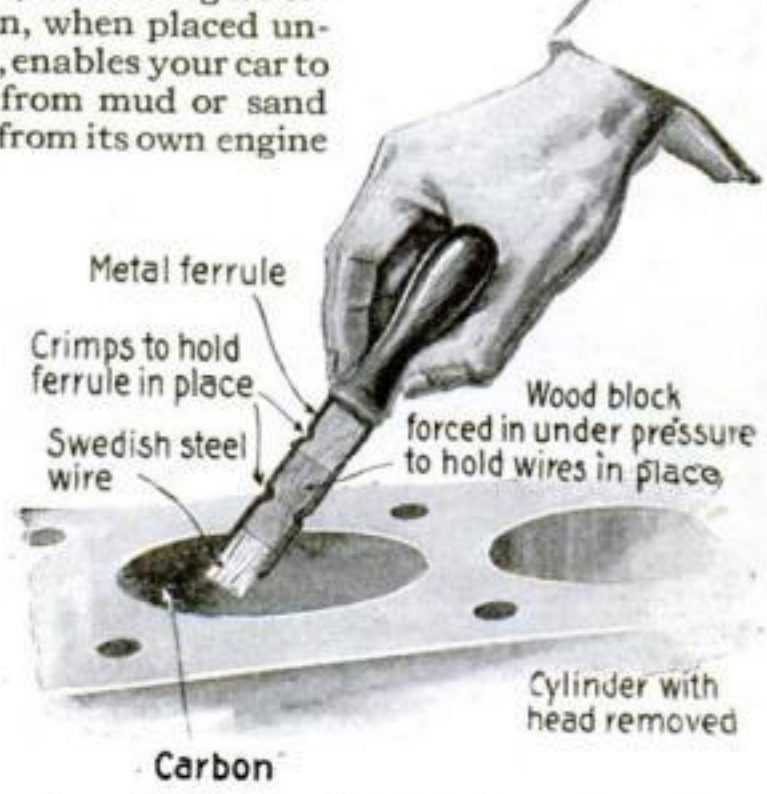
Why not grind your feed by applying a shaft and pulley to the crankshaft?

A portable track, resembling an ordinary tire chain, when placed under a rear wheel, enables your car to extricate itself from mud or sand with the power from its own engine

A light provided with a reel of cord can be carried to the rear of the car

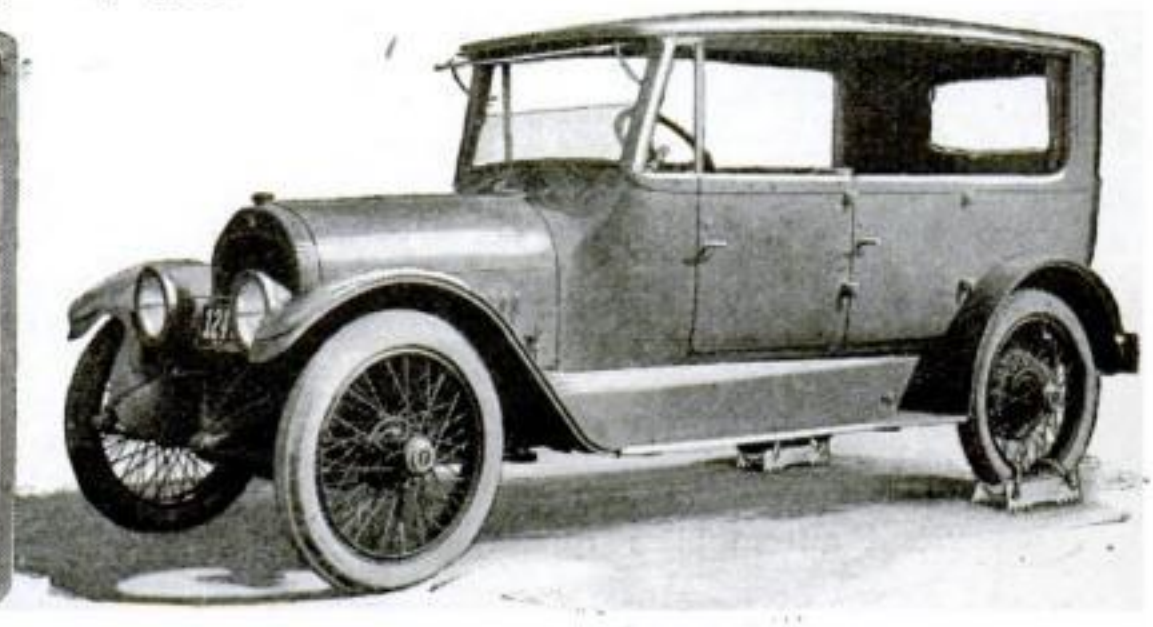


A new grease cup with non-stripping threads, has a central guiding post



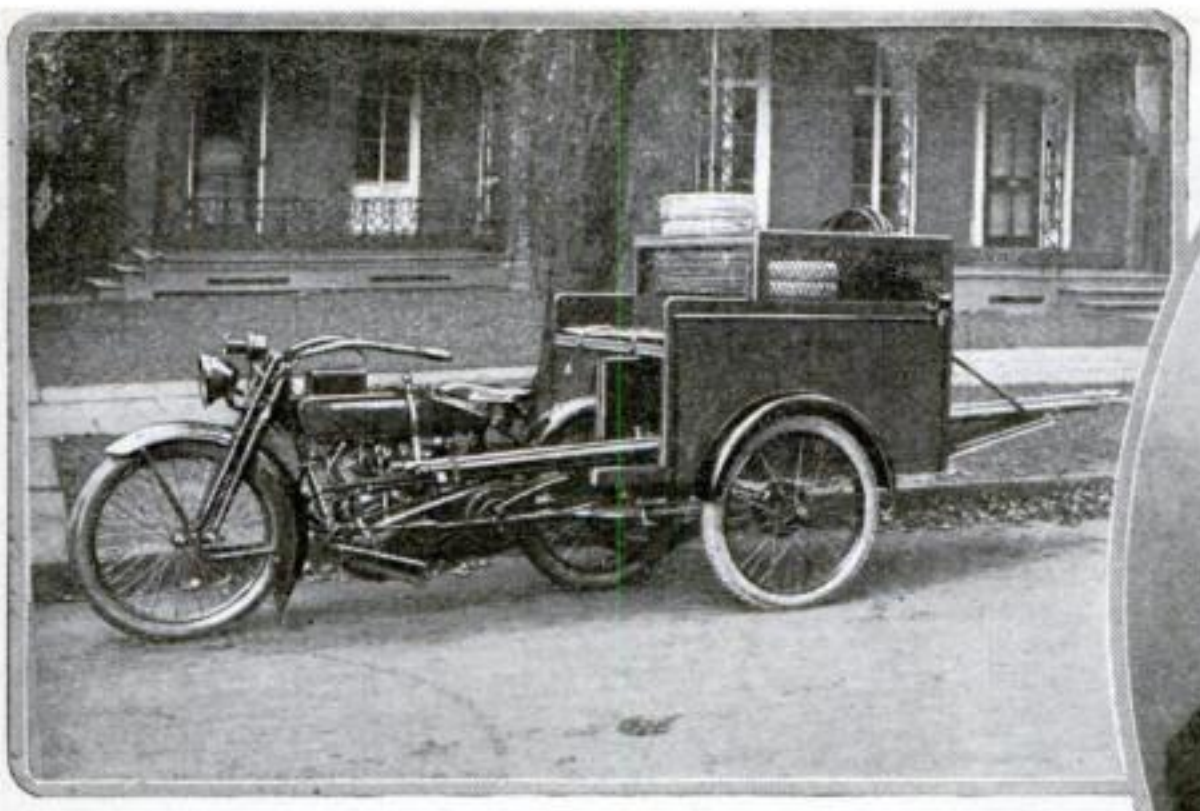
A carbon-removing brush of stiff steel wires held in place by a wood plug. It is operated through the spark-plug hole or, more conveniently, through the cylinder head, to clean the entire explosion chamber. The loosened carbon is then blown out in the usual way

This sharp-pointed clamp is a protection against thieves. It is closed by a lock near the rim. The other end is hinged



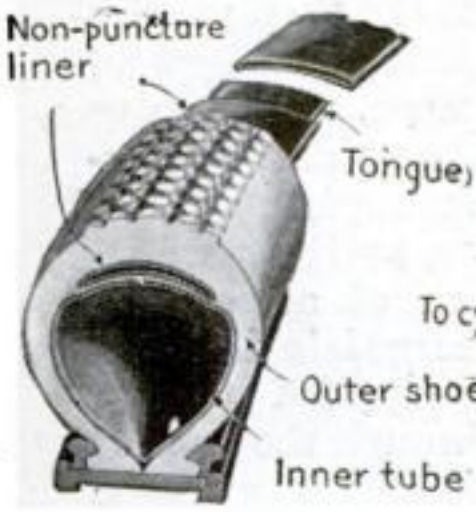
Metallic shipping shoes for automobiles, which hold the rear tires off the floor and at the same time hold the car securely in its moored position

Your Automobile Into the Super-Efficient Class

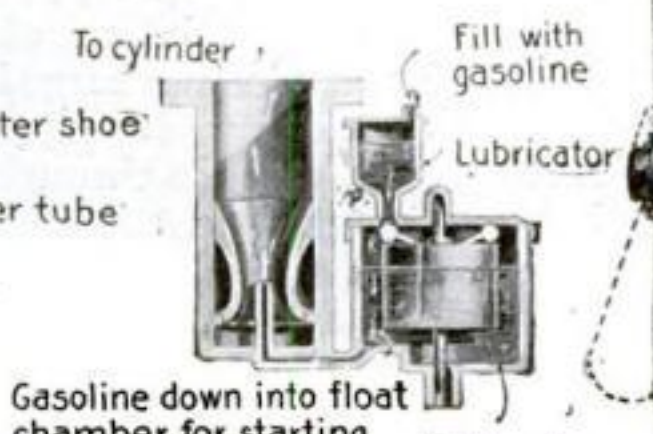


Contractors are attaching rear cars to their motorcycles to carry a complete line of tools and equipment. Twelve-foot lengths of pipe can be accommodated

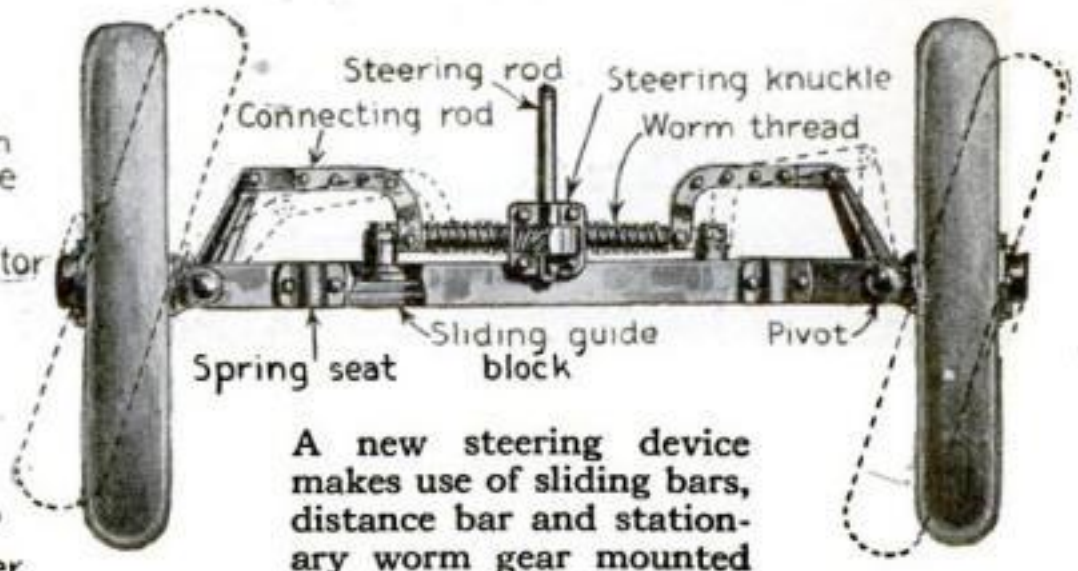
Behold the new form of hat for women, which makes goggles unnecessary. The simple peak device deflects the air currents



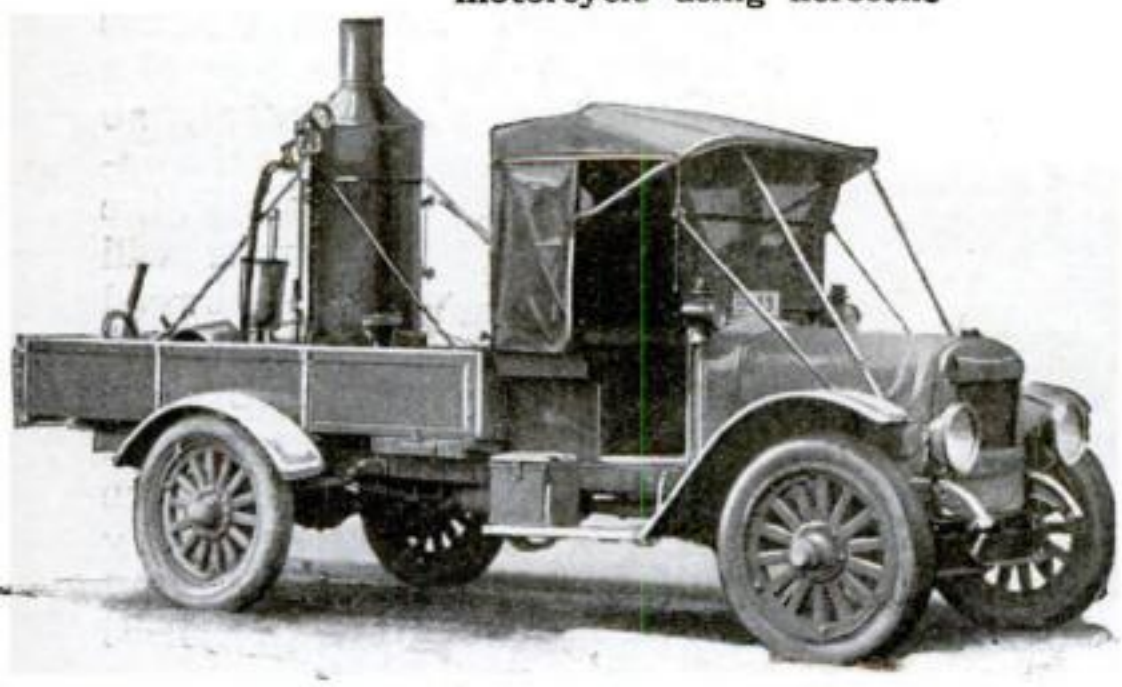
A non-puncture liner for pneumatic tires. Steel sections are used between the casing and the tube



A lubricating cup for gasoline is used in starting a motorcycle using kerosene

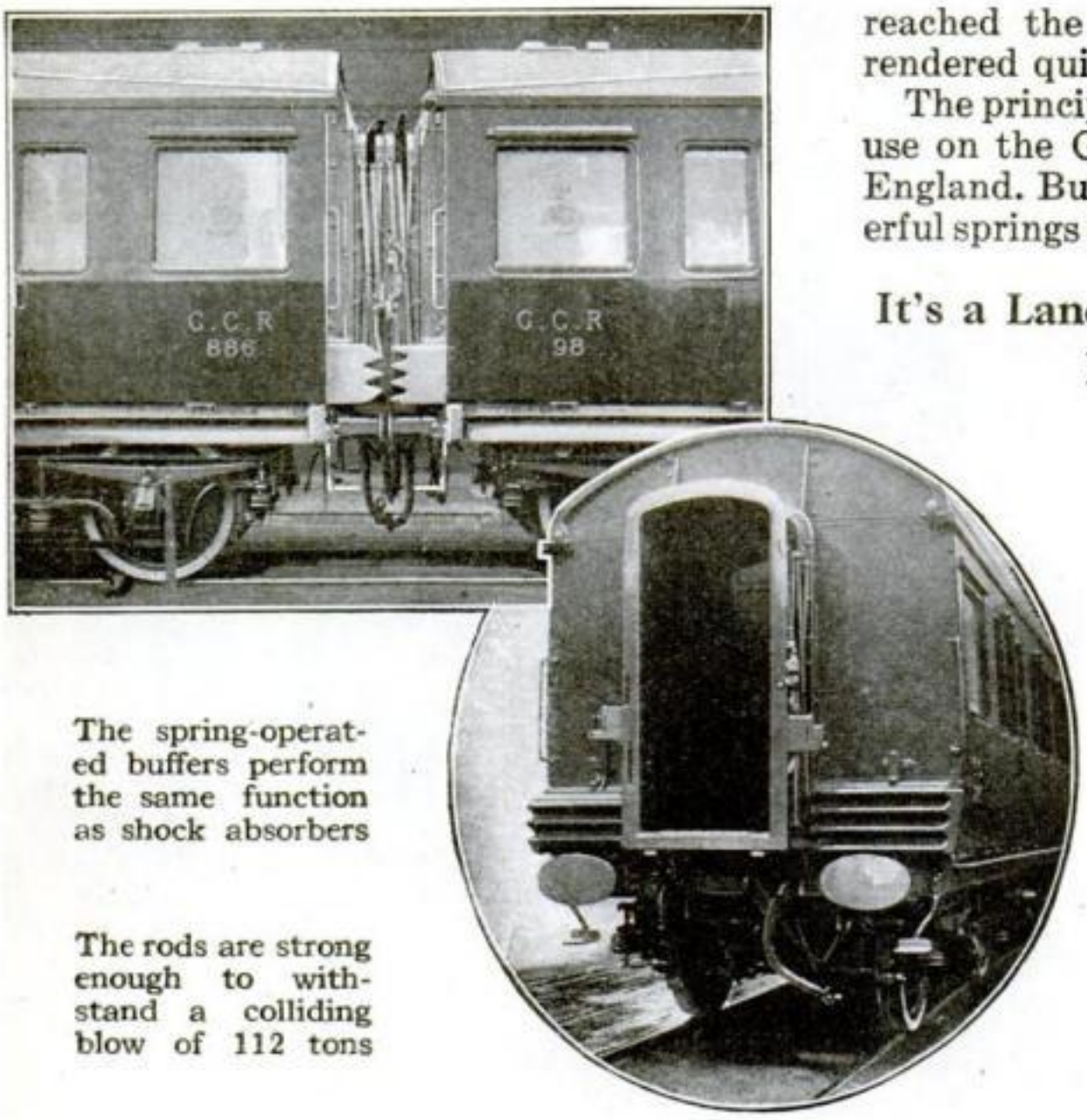


A new steering device makes use of sliding bars, distance bar and stationary worm gear mounted on the axle of the car



In Grand Rapids, motor-trucks will thaw out frozen hydrants this winter. Steam boilers, mounted in the position shown above, will do the thawing

So that you can ride over a curbing in your automobile, two boards are attached to string pieces, the top one being supported by the curbing



The spring-operated buffers perform the same function as shock absorbers

The rods are strong enough to withstand a colliding blow of 112 tons

Preventing Cars from Telescoping by Means of Collision Buffers

IN many railroad accidents the amount of destruction of life and property is considerably increased by the telescoping of the cars, one into the other. Due to the very rigidity of the cars, the force of the impact which meets the first car is transmitted to those following.

This is due to the lack of suitable cushioning apparatus between the cars. If some sort of workable absorber were placed near the coupling, the shock of the collision would be diminished as it traveled along the line. The first device would take up a portion of the blow and the second would take up still more. By the time the concussion reached the fourth car it would be rendered quite harmless.

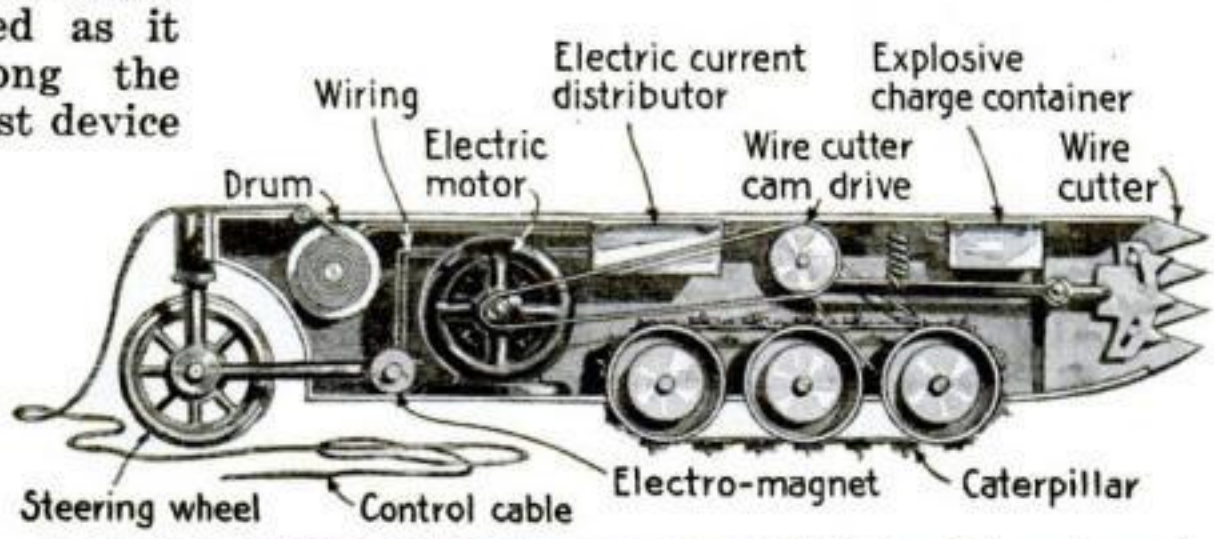
The principle is being put to practical use on the Great Central Railroad, in England. Buffing rods attached to powerful springs are being used with success.

It's a Land Torpedo and It Eats Barbed Wire

THE land torpedo illustrated below is the interesting wartime invention of Henry E. Elrod, of Dallas, Texas. It has been designed to travel on land, under the control of an operator who may remain at a comparatively safe distance from the enemy. The torpedo is caused to advance, and turn to left or right, as circumstances may require, by the manipulation of an electric switch. The explosive charge is in the head.

Electric current is supplied to the motor in the torpedo through the operating and control cable. This cable is wound on a drum and paid out as the torpedo advances. The caterpillar method of locomotion is employed.

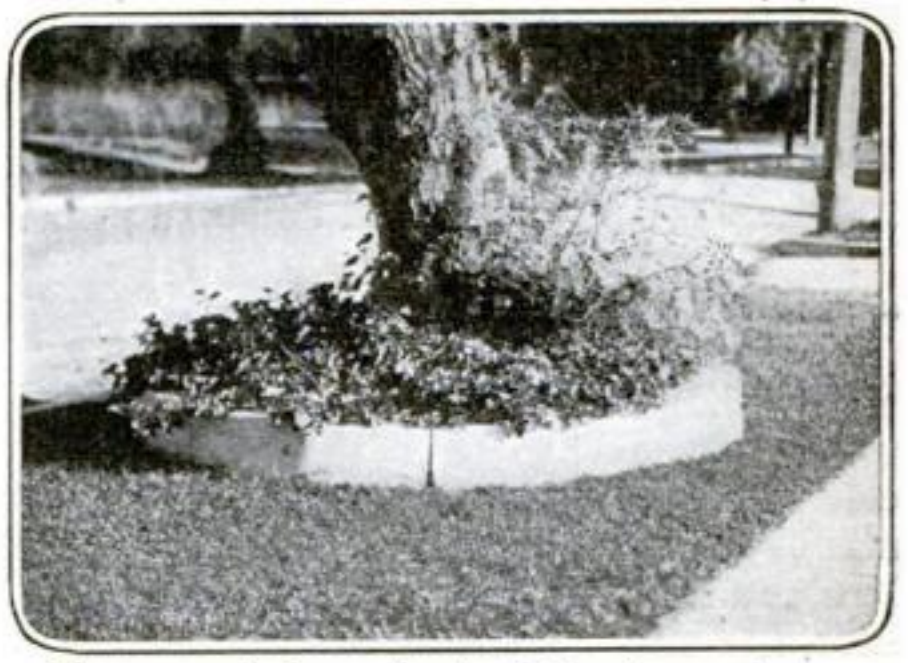
When the nose of the torpedo encounters barbed wire entanglements, the operator immediately causes its steel wire-clipping jaws to gnash, cutting an opening large enough for the head of the torpedo to force its way through. The shape of the torpedo is similar to that of the bow of a vessel, so that the opening in the barrier will be enlarged as the torpedo goes forward. Its sides are perfectly smooth, and entirely free from projections.



An electric switch controls the movement of the land torpedo and accurately guides it. The operator remains at a safe distance away

The Miniature Farms and Vineyards of France

ON the islands of Ré and Oléron, near La Rochelle, France, are found the smallest farms in the world. Some of them are only one or two square yards in area, yet these tiny domains are carefully planted with a variety of crops, even including vineyards. The soil is extremely fertile. The repeated subdivision of estates among heirs and the dense population of the islands explain the existence of these Lilliputian properties.



The concrete box safeguards the tree and very much enhances the beauty of the street

Concrete Flower Boxes to Protect Exposed Tree Roots

WHEN Marengo Avenue in Pasadena was extended recently, the grading incidental to the paving, left a lot of fine old pepper trees with some of their roots "high and dry." In fact, the exposure of the roots was so great that the city forester feared that the trees might be killed or their health seriously impaired.

Accordingly, to insure the safety of the trees, concrete boxes were built round the trunks and were then filled with rich earth. Plants with beautiful foliage were afterward set in the boxes.

Light Your Gas with Electricity—It Saves Waste

AN invention recently patented by Frederick C. Gutenberger, of Sacramento, Calif., seeks to do away with the use of matches for lighting the gas in range burners. The device consists of an electric battery or other source of electricity, one pole of which is connected with the top plate of the range. A wire connects the other pole with a coil to the other end of which is attached a wire of convenient length, ending in a pin. The wire going through the pin is in firm contact with a copper tip, somewhat smaller in diameter than the end of the pin into which it is screwed. When the gas is turned on and the burner touched for a moment with the copper tip of the pin, a spark will be formed by the closing and breaking of the electric circuit, and the gas will be ignited at once.

The coil, enclosed in a protective box, is fastened to a small board, which may be hung upon the wall near the range. A small hook screwed into the board will accommodate the lighting pin when it is not in use.

To light gas with a match is slow compared with the swiftness of electricity

Mr. Chinaman Must Have His 'Melican Cigarette

TEN years ago we exported four hundred million cigarettes to China, which is an average of about one cigarette a year for each Celestial. This year there has already been an average of ten cigarettes exported to each Chinaman, or, in round figures, four billion American cigarettes. Last year our exports in cigarettes alone reached the twelve million dollar mark.

The Electric Floor-Scrubber—It Saves Human Energy

IN a certain office building in Chicago, where fifty-six thousand dollars a year had been spent for floor cleaning by the hand method, the electric floor scrubber, illustrated here, has cut the cost of the work in half.

The electric scrubber is divided into two parts—the scrubbing machine proper and the wheeled mop and wringer.

The motor-driven scrubber washes the floor, while the mop sucks up the dirty water and deposits it in the tank at the rear

The operator of the machine plugs the electric cable leading to the machine motor into a socket on the wall. With the turning of the controller near the guide handles, the motor spins around, turning the eight weighted brushes around with it. Powdered soap and water from special holders are sprinkled in the desired quantities just ahead of the brushes.

The scrubbing machine is driven by its own power. The motor connects with the driving wheels by a worm and wheel arrangement under the carriage, so that the machine scrubs along at a pace of a hundred and twenty feet a minute. While the brushes—ordinary scrubbing brushes—spin around, scraping and washing all dirt from the floor, the electric cable feeds from the drum mounted beside the motor. The gear connecting this drum with its motor lets out the cable in such a way that no slack wires lie loose on the floor.

The mopping machine, which like the scrubber, is the invention of George W. Meyers, a mechanical and electrical engineer of Chicago, is even simpler in construction. It is wheeled along behind the scrubbing machine and by means of a duplex plunger, it sucks up the dirty water and powder.

Mooring the Rotted Telephone Pole to Prolong Its Usefulness

THE ever increasing cost of lumber has led to the use of many devices to save wood. One of the most ingenious is the method to save telephone poles, which rot at the base just above and below the surface of the ground. The upper portion remains sound for a longer time than the base.

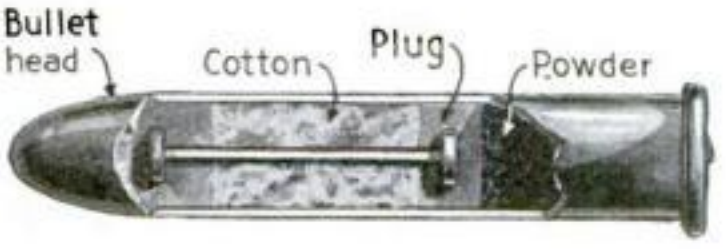
A short pole, creosoted so as to withstand decay, is placed in the ground beside the old pole and firmly fastened to it. This adds several years to the length of time the pole will serve. The arrangement also serves as a protection to pedestrians; for since the part buried rots long before the upper part, the fall might occur most unexpectedly.

To make the old pole last longer it is moored to a short pole treated with creosote

Cleaning a Rifle Barrel by Shooting a Cartridge Through It

A MAN in Helena, Montana, has devised a cartridge that cleans a rifle barrel. He uses an ordinary lead bullet, connected by a short rod with a lead plug which is set against the powder charge. The space between bullet and plug is filled with compressed cotton, which expands and rubs along the bore, wiping out the loose fouling.

A very serious objection to this plan is that the powder charge is behind the cotton, and deposits a new load of dirt in the bore. Moreover, rifles firing smokeless powder can not be cleaned without nitrocleaners. Neither is the plan practical for guns shooting the modern black powder.



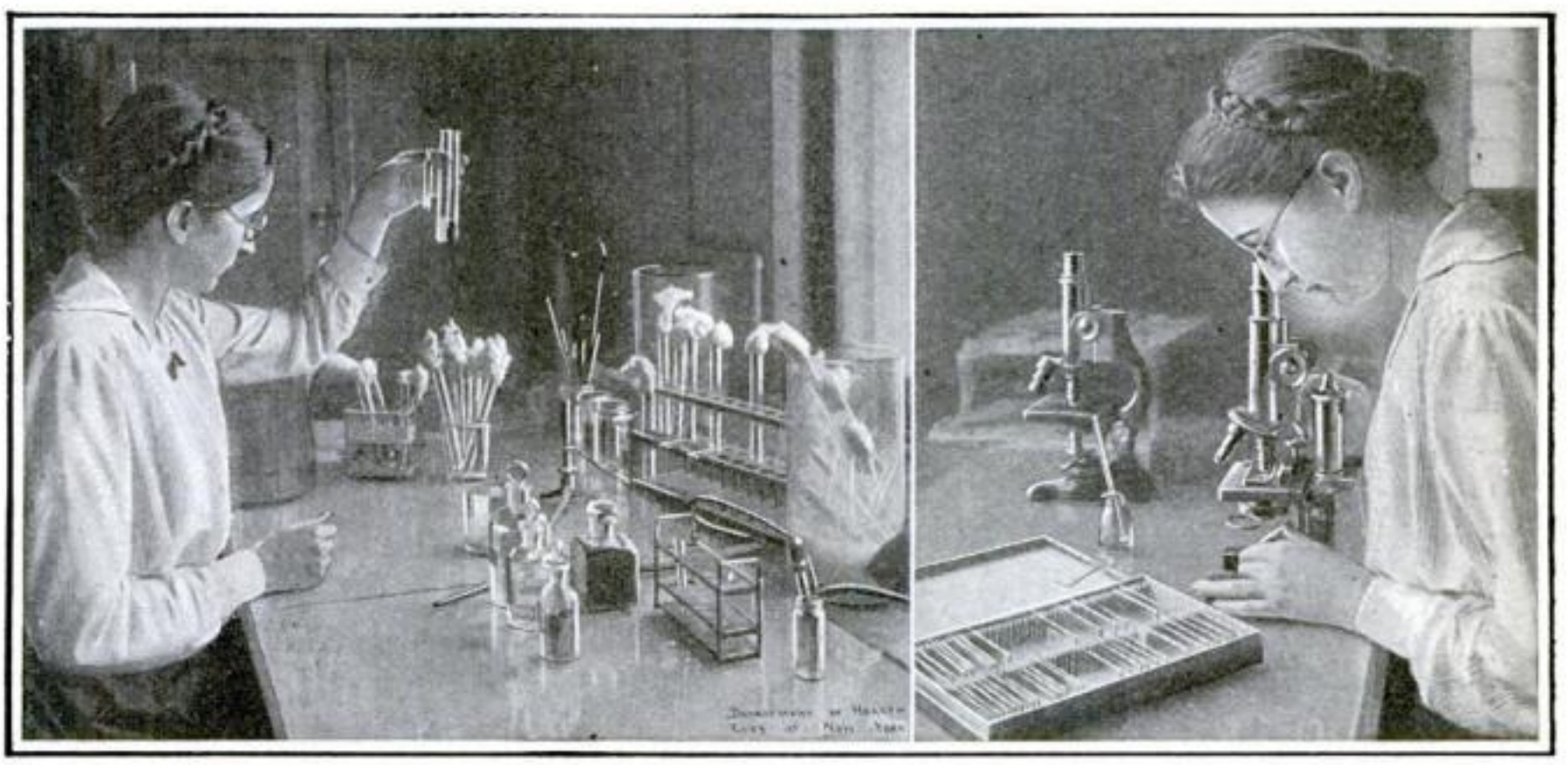
Compressed cotton rubs the bore, wiping out the loose fouling

What Spinal Fluid Tells About Our Soldiers' Health

IF one of the soldiers stationed in or near New York city is taken sick and his symptoms give rise to the suspicion that he is suffering with meningitis, word is sent at once to the Meningitis Division of the Department of Health of New York city. A physician from this Division goes to see the patient and to consult with the physician in charge.

After both physicians have made a thorough physical examination if it seems advisable, a puncture is made, to obtain the spinal fluid for examination in the city's research laboratories. If the patient is suffering from purulent meningitis, which is meningitis due to the presence of certain germs, the fluid will be cloudy. In cases of tuberculous meningitis, infantile paralysis, pneumonia and infectious diseases the fluid is clear. If it is cloudy or if the physician suspects that the disease is a case of epidemic meningitis, serum is administered. Even if the case is not epidemic meningitis the patient cannot be harmed by the serum, and if it is, a great deal is to be gained by prompt administration of the serum.

The number of injections vary greatly. Generally not less than four must be given and frequently many more are necessary. The serum is never administered by syringe but by gravity. The spinal fluid is examined thoroughly and there is no room for doubt about a case when all the tests have been completed.



At left: Making a culture from the spinal fluid of a soldier suspected of having meningitis.
At right: Making a microscopic examination at the New York Department of Health

This Purse Will Teach Your Boy to Save

IF you want your boy to grow up with a clear idea of the value of money, buy him a purse like the one illustrated.

The purse is made of a long piece of leather sewed to provide eight pockets, one for each day in the week and one for savings. The boy divides his allowance into seven parts and places it in the seven compartments, named after the days of the week. Each night he should endeavor to have a little money left in the compartment marked with the name of that day. This is transferred to the eighth pocket, which is his savings bank. The eight pockets fold together compactly so that the purse will fit a boy's pocket. Each compartment has a flap which fastens with a snap.

The thrift purse has eight compartments, one for each day's allowance and one for savings

A New Truck for handling Five-Hundred-Pound Rolls of Linoleum

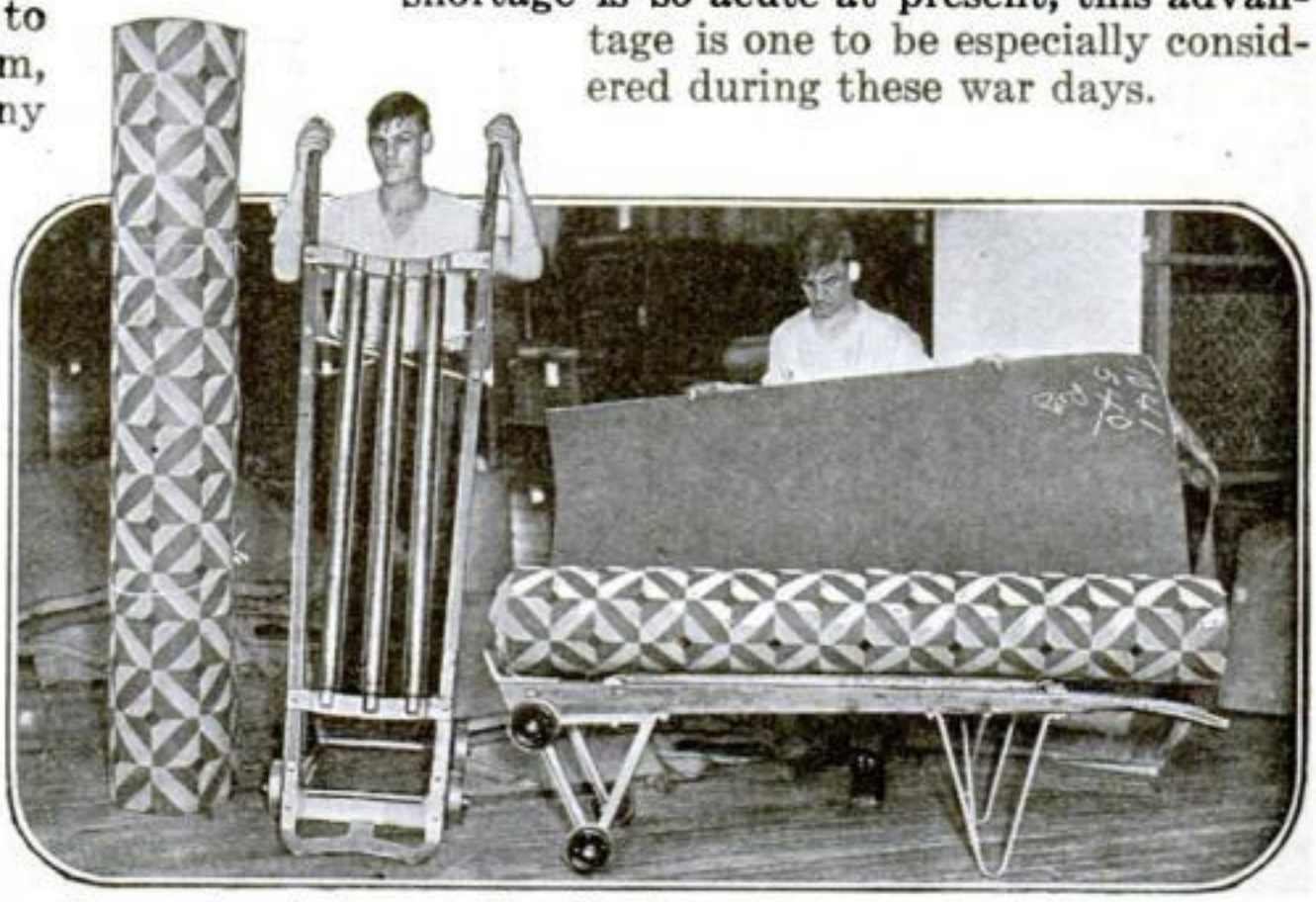
A NEW departure in the shop trucks, utilized to handle heavy rolls of linoleum, has sprung into favor in many factories and department stores. No ordinary two-wheeled, straight-backed truck is this. It has a four-wheeled chassis and a back which consists of three rollers, so that the handling of the rolls is easy.

When a five-hundred-pound roll of linoleum is to be carried from one place to another, the lip of the truck is slipped under the end of the roll and the whole is simply pushed along on the wheels. It is not necessary to tilt the body of the truck, nor to support the load.

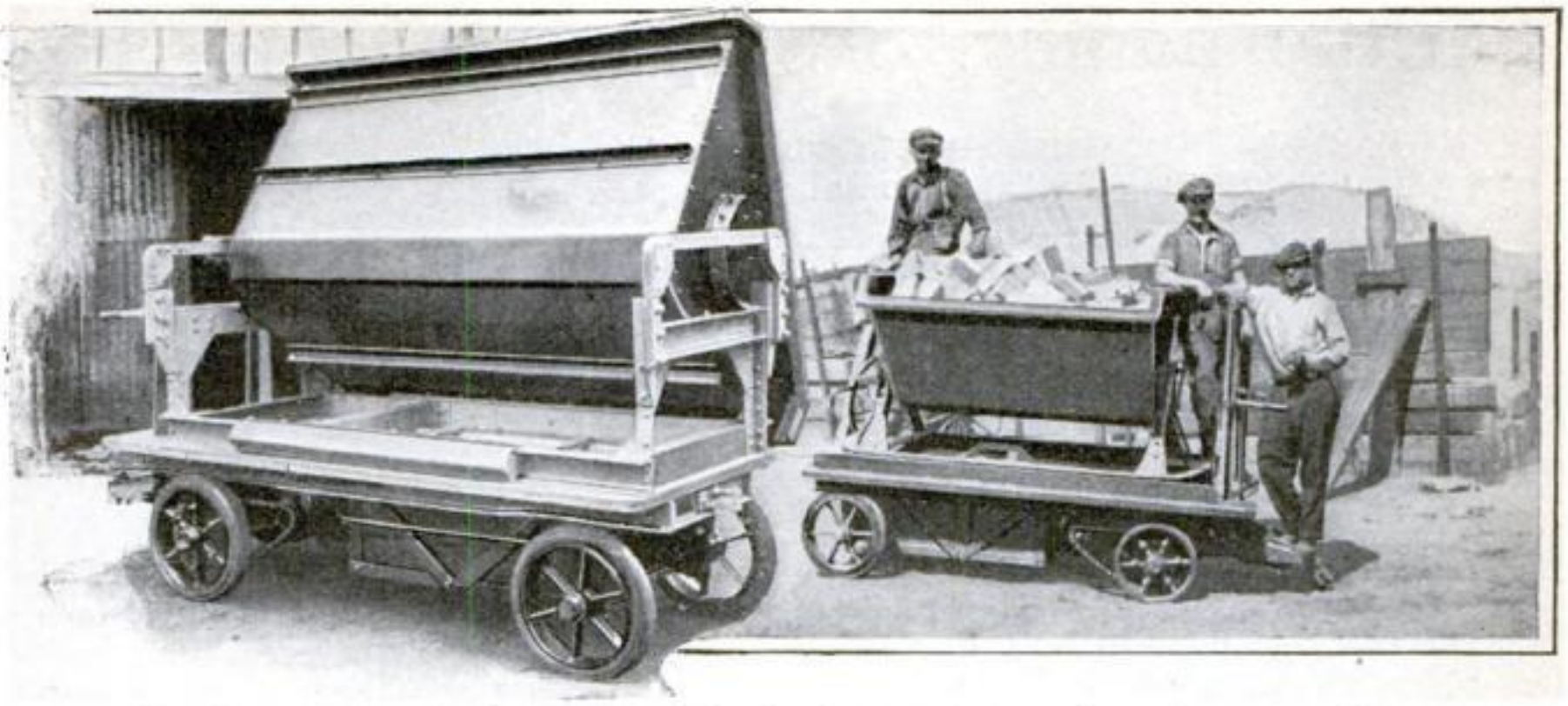
The entire weight is borne by the truck itself, and the four wheels, which run easily on ball bearings. When the man who is pushing the truck wishes to let it down, he simply lets go of the handles, guiding the handle-end of the truck to the floor. The weight of the linoleum bears it down, so that no force is required on the part of the truckman. The handle end of the truck is provided with two folding legs on which that end rests when the roll of linoleum is to be brought to a horizontal position, as it must be for cutting.

When the oilcloth or linoleum is in the horizontal position, as in the illustration below, the end of the cloth can be pulled out from underneath the roll with little effort. Less space is taken up in the operation than was formerly required.

Of course, this truck may be used for any heavy carrying which, without its aid, would require the labor of two men. As the labor shortage is so acute at present, this advantage is one to be especially considered during these war days.



In carrying the heavy rolls of linoleum, the four wheels of the chassis take the entire load. The piece is unrolled and cut on the chassis



The throw of the tripping lever unlocks the body and dumps it at the proper side. The load slides off. The body is brought back by means of roller bearings

This Type of Self-Propelled Truck Saves Even the Labor of Unloading

TO the long list of uses for the efficient little self-propelled electric truck—is added that of general hauler around factories. By the simple addition of a dumping body, the truck is now able to move everything from bricks to the actual factory products, with great facility. In the small space under the truck-body it carries an electric motor and power plant of storage batteries.

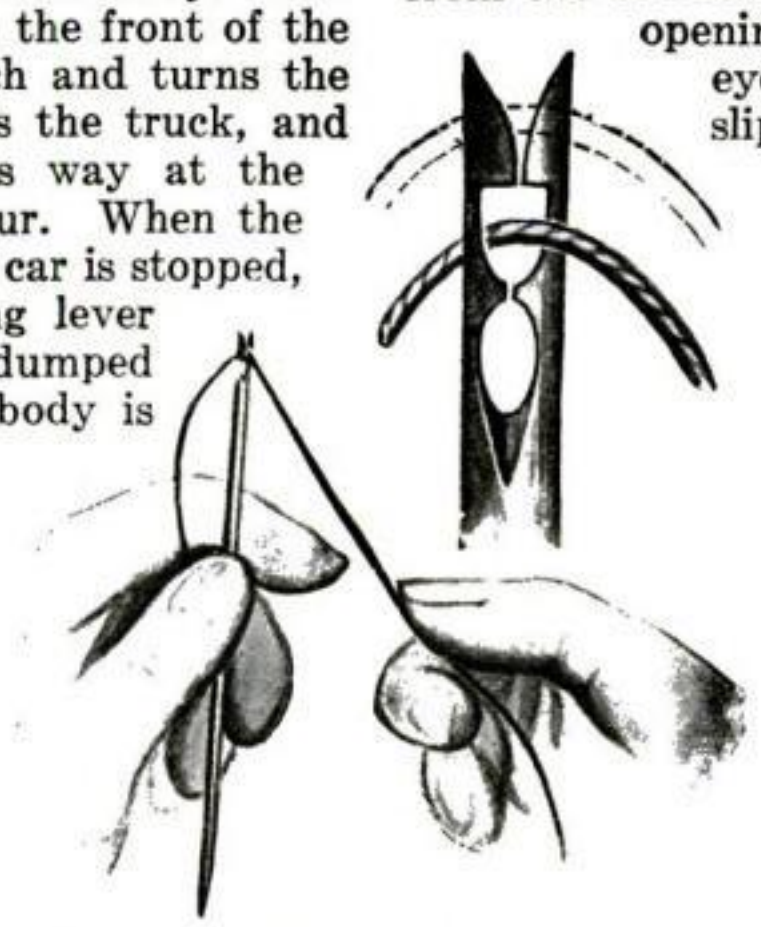
A load, weighing as much as a ton and a half, can be placed in this little body. The truckman then leaps upon the front of the truck, throws in the switch and turns the starting lever. This starts the truck, and the cargo is sped on its way at the rate of seven miles per hour. When the destination is reached, the car is stopped, and by means of a tripping lever the body is released and dumped at the proper side. The body is then brought back by means of roller bearings.

When flat or large loads are to be carried, the body can be removed and the ordinary platform can be substituted for it. The truck can further be utilized as a tractor. In this capacity it will very easily haul any load up to nine or ten thousand pounds.

A Needle That You Can Easily Thread in the Dark

NO matter how good your eyes are, there is always a certain amount of eye strain in threading a needle. If your vision is not as sharp as it once was, it is even something of a task to get a piece of thread through a needle's eye.

A needle has been devised which can be threaded by the simple expedient of looping the thread over the head of the needle and drawing it downward. The needle differs from the ordinary needle in that it has an opening through the top of the eye through which the thread slips when it is drawn downward. The steel ends spring close together as soon as the thread has passed into the eye.

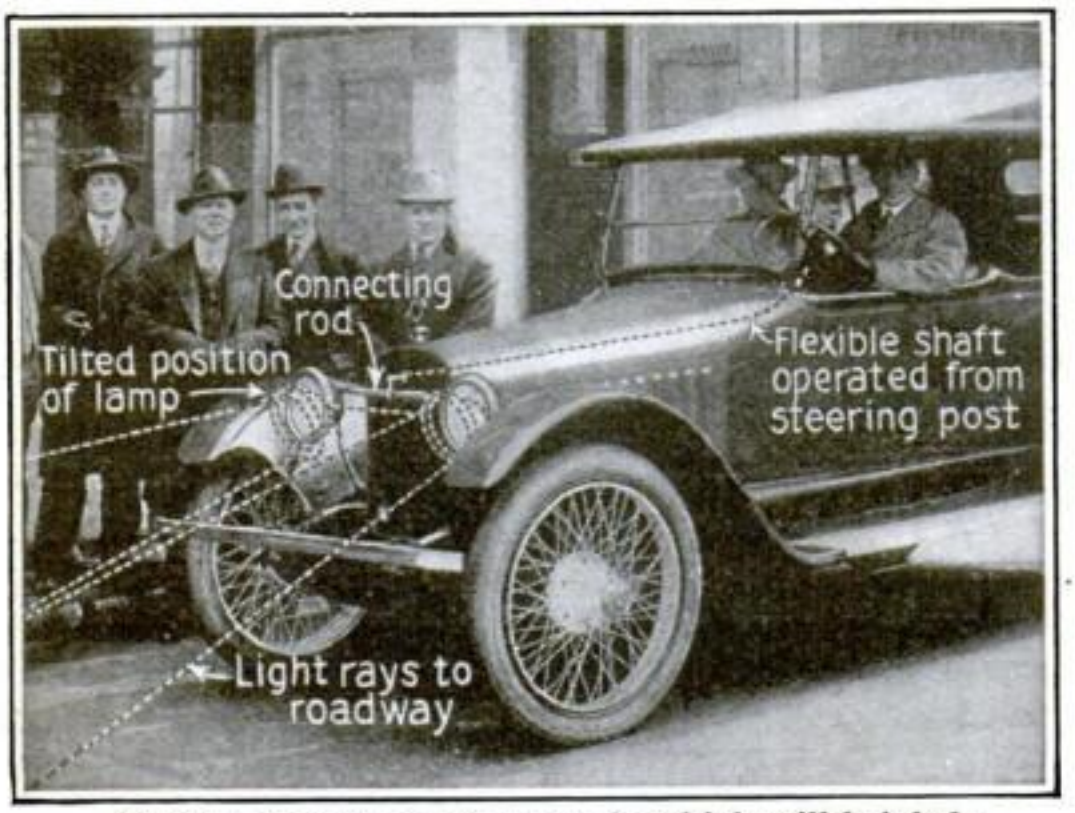


The thread slips through an opening in the top of the needle which closes as soon as the thread passes into the eye

This type of needle is said to be particularly adapted to the doing of fancy work because two or three threads may be passed through the eye at one time, a feat that is quite impossible with the ordinary needle. It is also useful for embroidering with worsted, the thick, clumsy threads of which make it necessary, usually, to employ a needle for the purpose which has a large clumsy eye.

Tip the Lamps to Stop Headlight Glare

Night and a curve in the road?
Pull the lever and swing the lamps



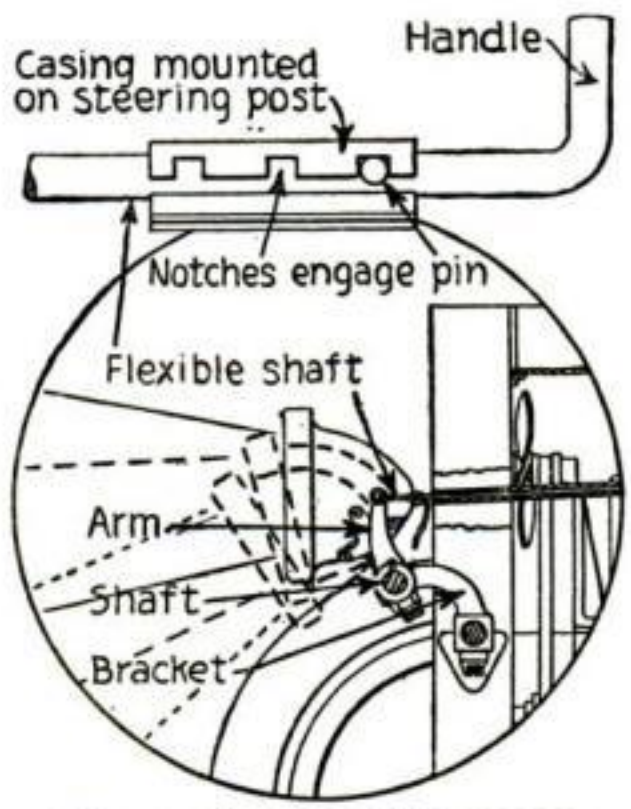
The lamps are set at an angle which will brightly illuminate the road without unnecessary glare

DEVISED to eliminate the disadvantages of the various types of automobile headlight dimmers now on the market, which either do not prevent glare or reduce the light to such an extent that it is not sufficient for country driving, a system of tilting head lamps has been invented.

It enables the driver to set the lamps at any desired angle so that the light may shine fully upon the road with the rays parallel or at an angle to the ground. The tipping head lamps also enable the driver to quickly secure the full headlight illumination after the use of the dim headlights. This is of especial importance in country road driving when it is essential to dim the lights upon passing another vehicle and to resume the full brilliancy immediately afterward.

Although the invention may be applied to any make of car, the design shown in the accompanying sketches, is particularly adapted to Ford automobiles and may be applied to them simply by the removal of the ordinary head-lamp brackets.

The device consists of one transverse shaft carrying two headlights and mounted in two bearings bolted to the front frame member in front of the radiator. A bell-crank lever arm is keyed to the shaft and is pushed backward or forward by means of a flexible metal shafting inserted through a hole cut in the radiator core and then carried to the rear under the motor hood to a point on the steering column directly below the hand wheel. The lamps are tilted downward from their vertical position by twisting the flexible shaft slightly on its axis so that a pin driven through it near the end on the steering column is enabled to slide in a slot with three notches cut in the casing over the cable end. A longitudinal movement is then given to the shafting by means of a small handle so that the bell-crank lever is moved forward or backward. When the handle is again released, the pin will quickly spring back to the next notch by reason of the energy stored up in the flexible shafting resulting from its being twisted. A further movement of the handle tips the lamps to a still greater degree while the longitudinal movement in the opposite direction similarly brings the lamps back to their normal position. The operating lever is so easy to turn that the driver need not divert his eyes from the road to manipulate it and move the light where he wants it.



The mechanism which moves the lamps at the pull of a lever

Like Water from a Hose

A method of Spraying Asphalt by hand—good for tight places

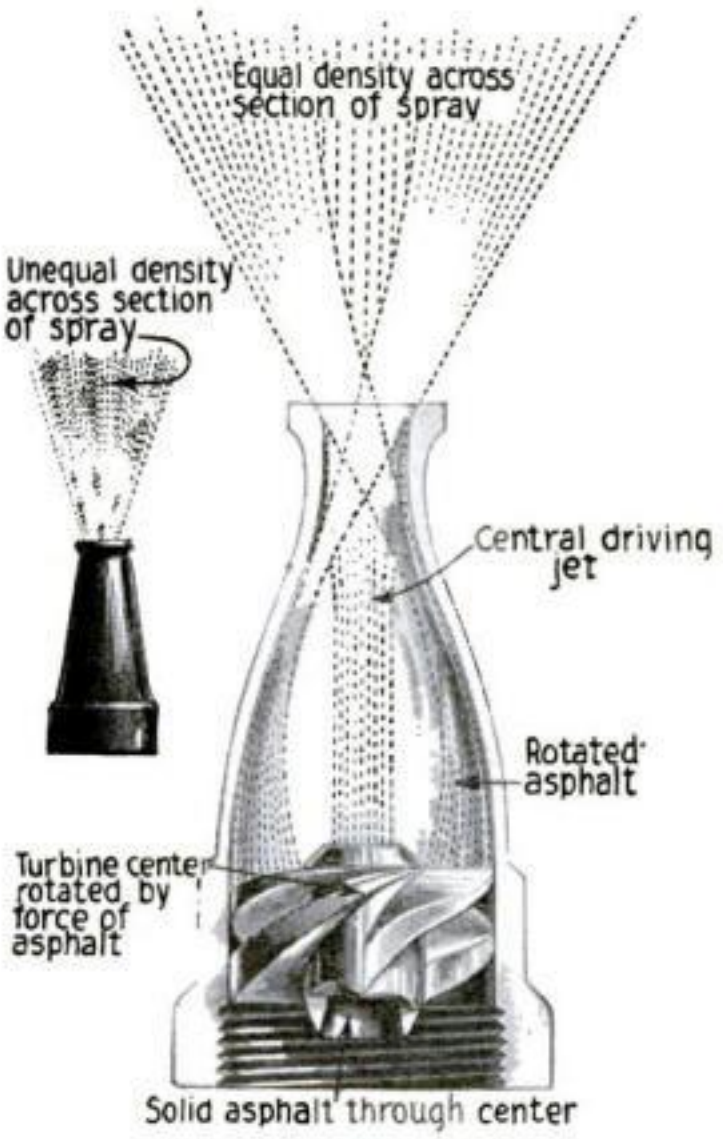
The asphaltic material is heated and applied under pressure from a gasoline-driven rotary pump

A NEW type of nozzle, made by a Boston manufacturer, is designed for spraying hot asphalt-binder in road construction or on sidewalks, where the use of a large motor-truck outfit would be unsuitable. The hot fluid is uniformly sprayed at a temperature of 350 degrees Fahrenheit and at a pressure of forty pounds per square inch. The high pressure causes the asphalt to permeate all the voids between the stone, which it is intended to bind. The portability of the apparatus makes it possible for this to be accomplished easily. With a motor-truck it would be almost impossible to reach the corners.

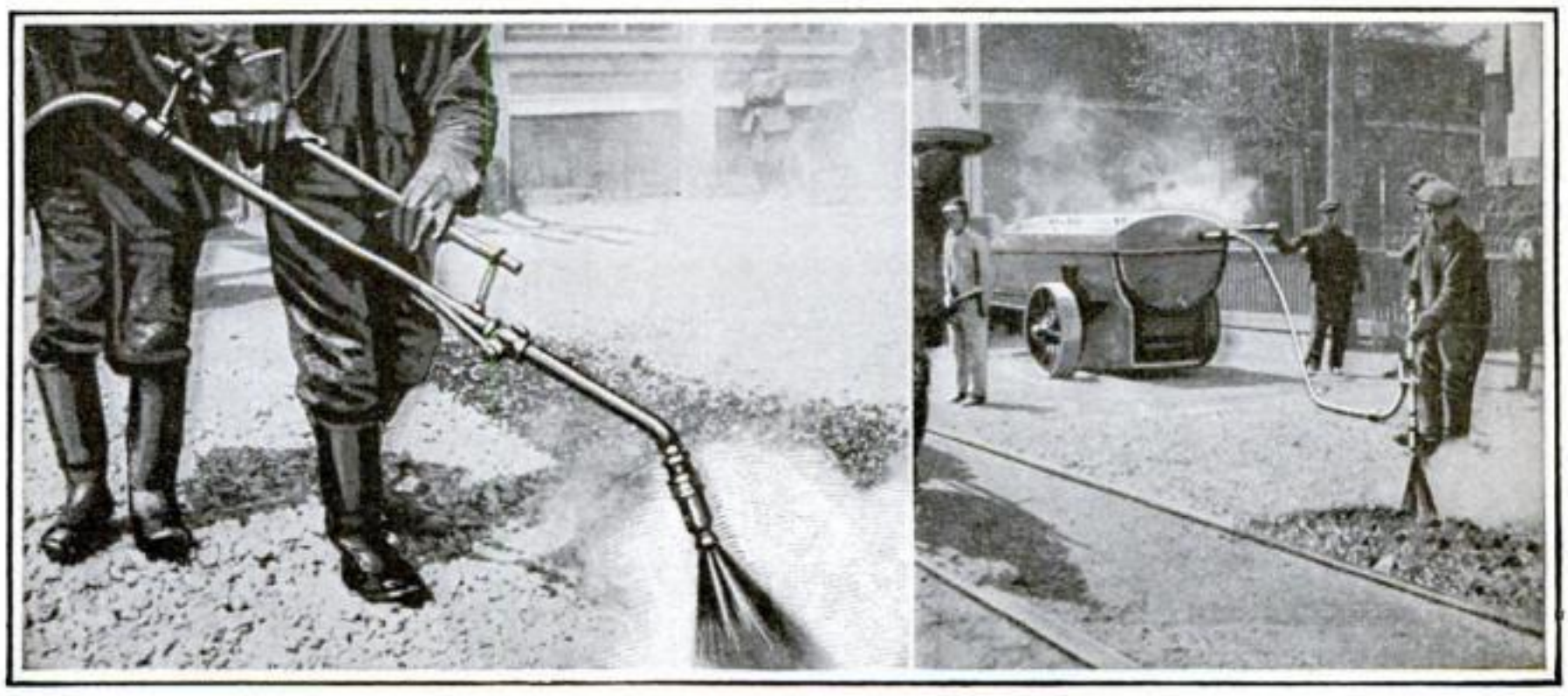
The sprayer can also be used for patching holes in bituminous roads and for applying roof coatings.

The asphaltic material is heated in the usual manner and put under pressure by means of a gasoline-driven rotary pump. It is then carried to a special nozzle by means of a hose. The nozzle has a fixed turbine center which disposes of the liquid in such a way that a dense uniform spray is obtained. This prevents the material from being too thick in some spots and too thin in others.

The turbine in the nozzle is stationary, yet removable, and gives a part of the liquid passing through it a rotary motion. This portion is driven out through the orifice of the nozzle by the central driving jet.



The nozzle has a turbine center which controls the density



The liquid asphalt is carried to the special nozzle through a hose. The nozzle sends it out in a solid conical formation of equal density across its section

The Soldier's Belt Is a Chandelier. It Even Holds His Flashlight

A GLANCE at the accompanying photograph shows how completely equipped the United States soldier is for emergencies. His hands are free, his gun is ready and he is literally "girded for the fray." The belt that "girds" him is an important part of his uniform. Only the wearer knows all that it carries attached to it. It is not the ordinary cartridge belt, but is the one used while on special duty or for comfort and convenience around the camp.

The special feature which this photograph shows is the flashlight fastened to the belt and held in position to throw its light directly ahead. The man on sentry duty will see the advantage of this arrangement, as well as the busy boys in camp who must often clean their guns after nightfall.

The flashlight is fastened to the belt, so that it throws its light straight ahead

Clearing out Sewer Pipes with Compressed Air

BRADFORD, England, has a sewer five miles long with a drop of 70 feet in distance. The grade is not uniform. As the sewage is loaded with heavy, solid matter, the flow was not what it should have been. The city did not want to resort to pumping because of the expense. One of the city engineers hit upon the idea of using compressed air at a pressure of eighty pounds and discharging it at regular intervals into the sewer. The plan was carried out with great success. It has been done for some time now without a recurrence of the difficulty.

Another Automobile Kitchen to Follow Our Boys at the Front

FEEDING our soldiers is an important matter, and the problems it presents have interested many of our inventors. The traveling kitchen, run by motor power, is a very natural product of the times. There are several types. One, which the United States War Department is considering, is shown in the accompanying illustration.

The kitchen with its big kettles, large enough to cook food for two hundred and fifty men at one operation, is mounted upon an automobile truck, which can also carry reserve supplies to feed two hundred and fifty additional men.

For the chauffeur a protected cab is provided in front and the cook may attend to his work in the kitchen even while the truck is moving from place to place, by standing upon a step in the rear. To prevent his being jolted off on rough roads a hand rail has been provided to which he can hold.

One of these automobile kitchens can cook food for two hundred and fifty men at one time

Studying Germs on Wheels

Climb on board this automobile and see if the water you drink is pure

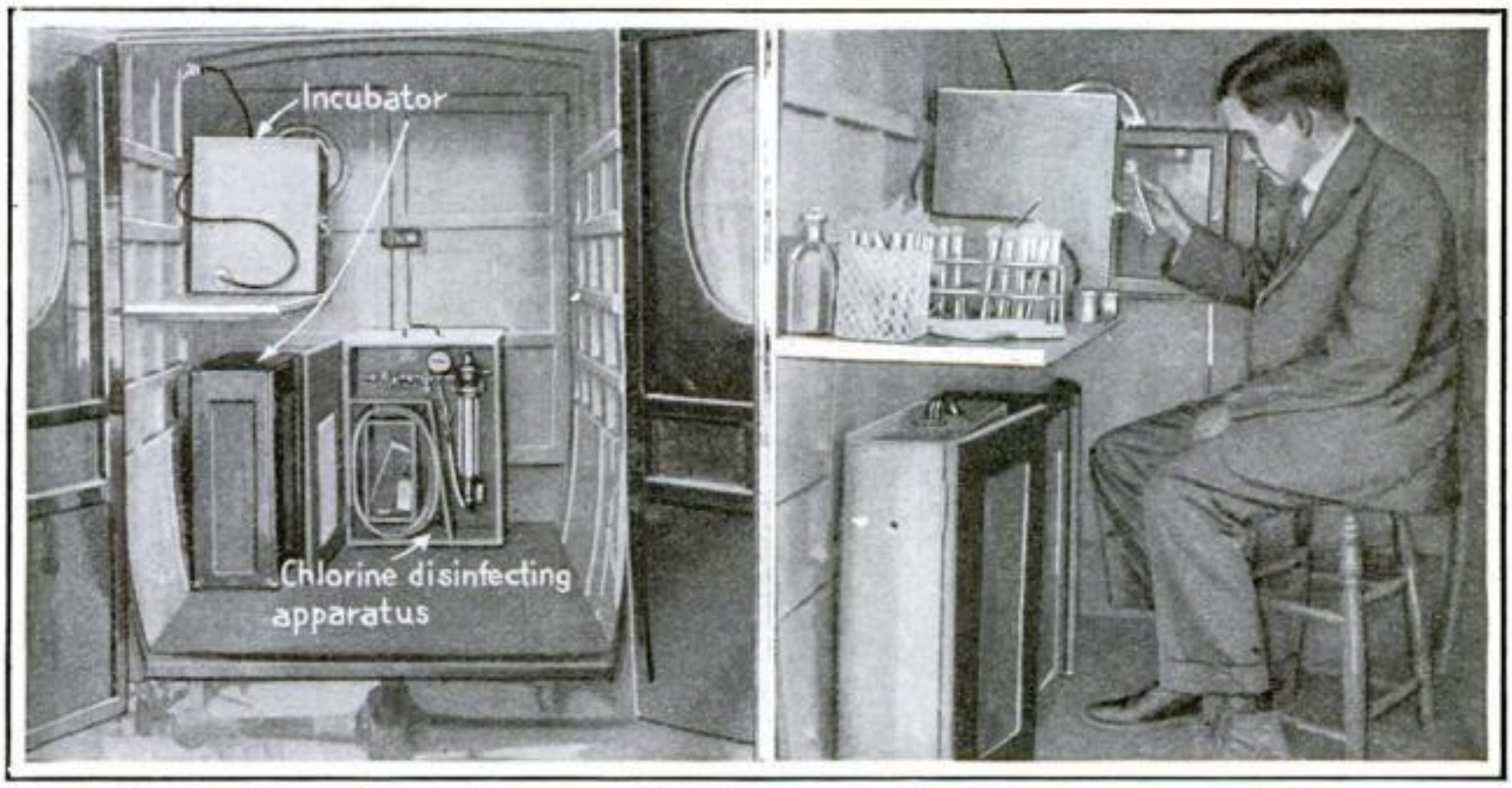
SCIENCE has made wonderful progress in devising methods of quickly discovering sources of danger to public health by the pollution and contamination of food and water supplies, and has found means of counteracting the dangers threatening from germs and other impurities. But promptness of action is imperative in all cases, and in recognition of this fact, the efforts of the health authorities in all states have been directed toward finding some means of expediting the work of the health officials and enabling them to cover every locality requiring their services without dangerous delay.

The Department of Health of the State of New Jersey has recently introduced a traveling field laboratory mounted on a motor chassis. In outward appearance the vehicle resembles a delivery wagon. The closed and covered body has doors in front and in the rear, and forms a small room used primarily for bacteriological work. On one side of the inside wall is a bench or shelf upon which rests two incubators which are heated by electricity from a storage battery, which also operates the starting and lighting system of the automobile. The shelf also provides enough room for the making of

The laboratory on wheels is the family doctor for New Jersey water systems

culture plates and for their examination for the purpose of counting the germs. The incubators may also be removed, and, by changing the voltage of the heating lamps, may be used on any 110-volt circuit at any water-pumping or filtration plant.

Another portion of the equipment carried by the automobile is a portable chlorine gas disinfecting apparatus by means of which any water supply found to be unsafe may be purified by the addition of chlorine gas. By means of this traveling laboratory the necessary inspection of dairies and water supplies in various remote parts of the State has been greatly expedited.



The interior of the laboratory. At left appears the chlorine gas disinfecting apparatus and at right an inspector is shown making a chemical analysis

A Medicine Cover Which Eliminates All Guesswork on the Part of the Nurse

MEDICINE that is to be taken a spoonful at a time, at intervals, should always be covered, especially if the sick person is lying in a room where the windows are open and dust enters. It is also equally important that the doses be administered at the precise time stated by the physician. It goes without saying that beneficial results can not be expected when medicines are administered irregularly, which is so often the case when memory is relied upon or where there are several persons waiting upon the sick one.

The minute and hour hands on the cover tell the nurse exactly when the medicine should be taken

A medicine cover which will remind you when the next dose should be taken, is a recently marketed article. The face of the cover, which is made of wood, is neatly colored and numbered from one to twelve in clockwise fashion. An hour hand and a minute hand are pivoted to the center. It is topped by a sympathetic appearing little figure by which the cover is lifted. After each dose is administered, the hands are set forward to the proper time for the next dose.

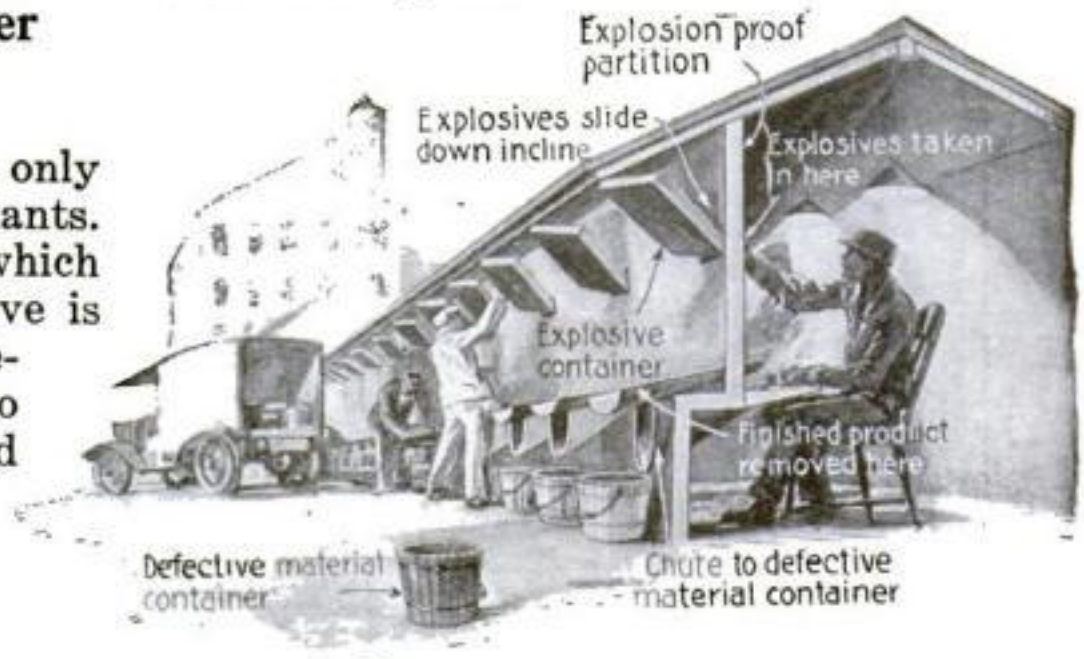
Shielding the Munition Worker Behind Steel Walls

FILLING the large shells is not the only dangerous task in the munition plants. Loading the shell primer and fuses in which only a very small quantity of explosive is used, is almost equally hazardous. A defective fuse, for instance, is likely to go off and to ignite piles of fuses and powder that are near it. This source of danger has been found so great in the experience of E. P. du Pont, of Wilmington, Delaware, that he has designed a special loading house to protect the workers.

The operator is separated from the explosive material by a steel partition. Only the few grains of powder required to fill one or two fuses are at hand. If these grains go off, little harm is done. If the big piles should be accidentally ignited, practically the entire force of the explosion would be spent in the open air, on the other side of this partition.

The trucks that handle the powder supply and that take away the stacks of the finished products, all run on the outside of the partition, which is really the outside of the building. The loose explosive is placed in the large conveying trays that are shown. By tapping these slanting trays, enough powder slides through the little neck of the tray to allow for a few fillings. This powder is then wrapped up in the fuse fabric and the product is immediately passed out on another tray near by. Fuses, that are wrapped too tightly or are made imperfect in any way, are slid down a chute into a shallow bucket to be taken away. In this way no one touches the dangerous parts.

The entrance of women workers into munition factories has inspired many foremen to make extra humanitarian efforts in behalf of their employees and those dependent upon them for support.

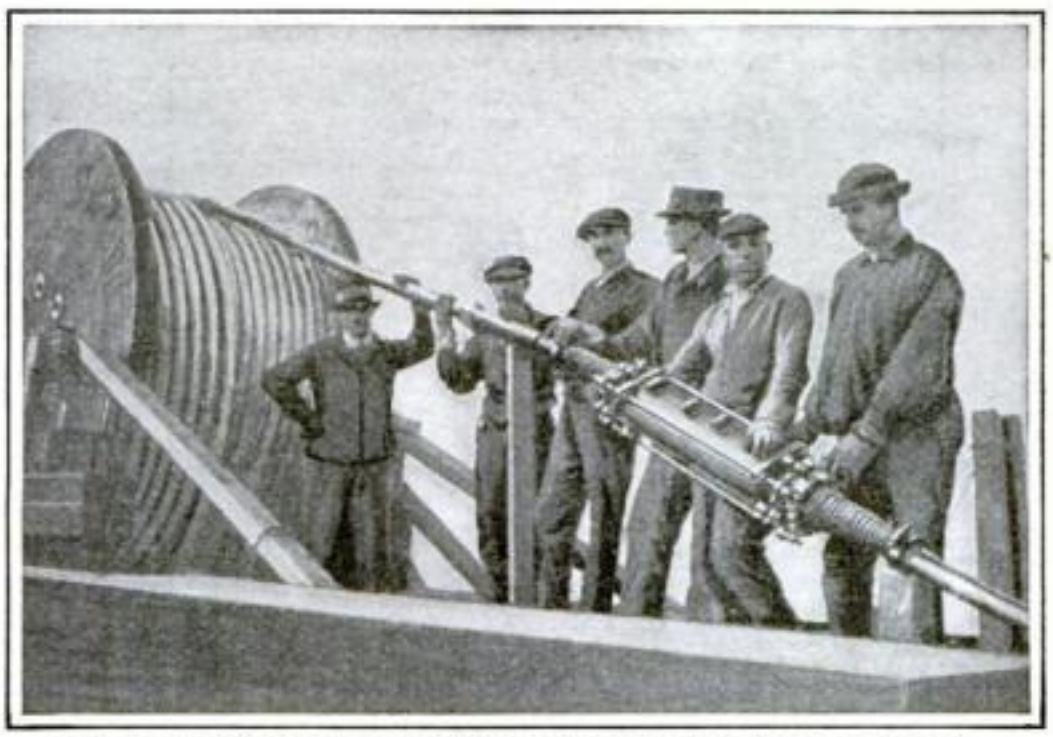


As a protective measure, the workers are separated from the piles of explosive material by steel walls

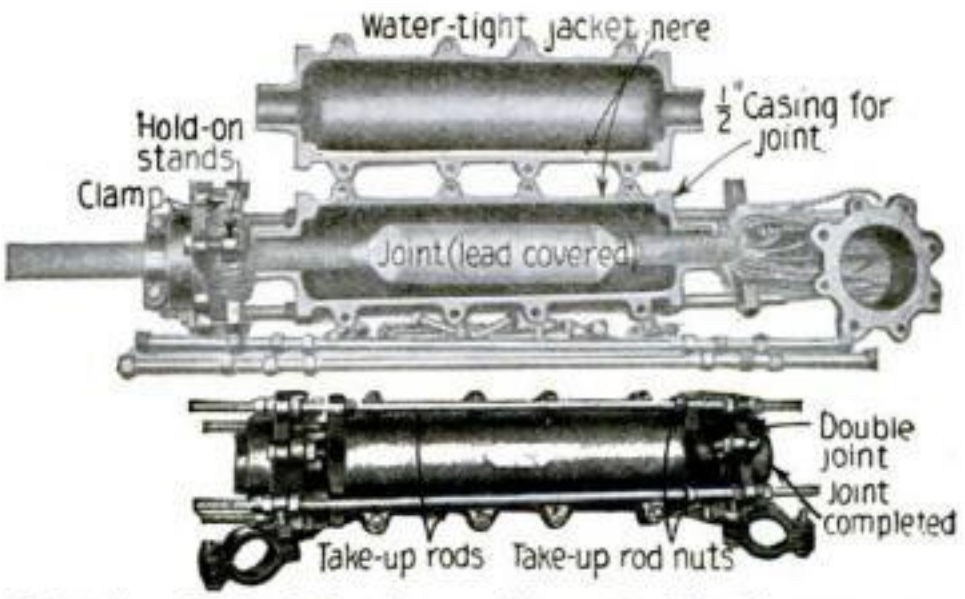
A New Joint Box Which Prevents Submarine Cable Breaks

THE new type of joint box, shown in the accompanying illustrations, has just been devised to prevent breaks at the joints, or splices of submarine telegraph and telephone cables, caused by the severe mechanical stresses set up in the cable because of the constant movement carried on by the tides and currents.

The box, which is made in two halves, is bolted together with a gasket between the two parts, in order to make it waterproof. Two double clamps are attached to the cable, one on each side of the joint and outside of the joint box proper. These two clamps are held in the proper relation to each other by means of four long take-up rods and nuts, which, when tightened up against the ends of the box, bridge over the joint and transfer any stress on one side to the other without causing any strain in the lead sheathing over the actual cable joint.



The new joint box which prevents breakage of submarine telegraph and telephone joints or splices



Details of the joint box. Two double clamps are fixed to the cable, one on each side of the joint

Bury the Coffee-Grounds in the Garden. They Fertilize the Soil

THE question of what to do with the coffee-grounds has at last been satisfactorily answered. Just pour them out into the sink-strainer and dump them into the garden. They contain some valuable fertilizing properties, including a large percentage of nitrogen and a fair amount of potassium and phosphorus.

How the First Potatoes Were Made Popular in France

ALTHOUGH potatoes were early introduced into Europe by the Spaniards, they did not come in any quantity for many years. The English found them in Virginia, but it is believed that the Spanish brought them to that colony from further south.

The first attempt to introduce them into France was due to a well known scientific authority named Parmentier. This was in the seventeenth century. He imported some of the plants, set them out in a field near Paris, and by means of learned pamphlets and talk with the people, tried to have the new vegetable brought into cultivation and the market.

But it was all in vain. Potatoes did not prove attractive; and when the planted ones matured, it seemed that they would rot in the ground on account of the prejudice against them.

Then some wise man who knew human nature—a student of psychology, with practical ideas—suggested that peasants could not be made to try potatoes by persuasion, but might be led to adopt them if they were forbidden to eat them.

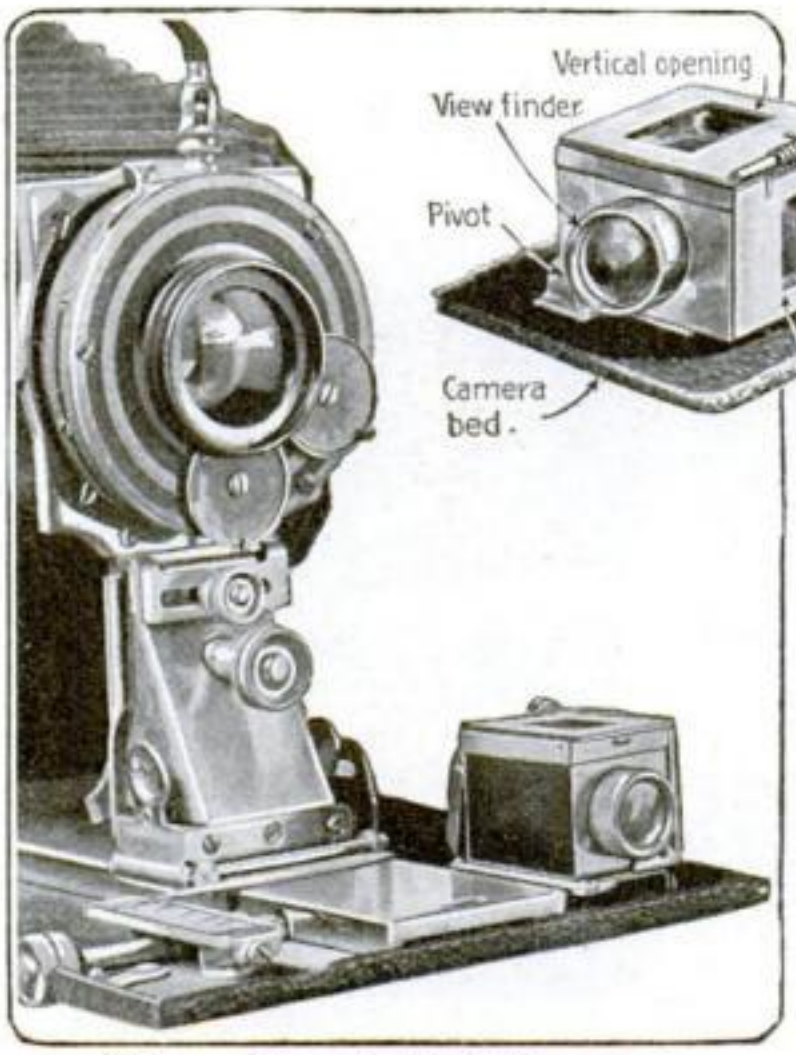
His idea was adopted. Many signs were painted and erected in plain sight, forbidding under severe penalties any one from taking any potatoes from the field.

The peasants at once began to raid the hills; and before long most of the ripe tubers were stolen and eaten with relish.

A Masking Device Which Brings the Whole Picture in the Photograph

EVERY once in a while the amateur photographer gets into trouble by turning his camera over to take a lengthwise picture, using the up and down, or the panel portion of the finder, to locate the object or person to be photographed. This often results in an unfortunate headless and footless portrait of the camera fiend's best friend. Two citizens of Indiana have invented a masking device which makes it impossible for even the most careless person to make such a mistake.

The device covers the top of the view finder, as the illustration shows, and permits the photographer to see the scene only as it will go on the plate or film. This effectually prevents the using of the wrong length of the finder—the panel portion for the horizontal picture.



The masking device fully covers the top of the view finder

A hinged flap contains the vertical opening for one position and another contains the horizontal opening. When the finder is rolled over, the vertical opening flap turns down beside the finder box and the finder moves until the ninety degree turn is complete and the hinged flap carrying the horizontal opening lies exactly across the screen.

There can never be even the possibility of a mistake with this device, because the shape of the opening over the focusing plate is automatically altered by the change in the position of the finder. By this simple means, inexperienced photographers may avoid many disappointments.

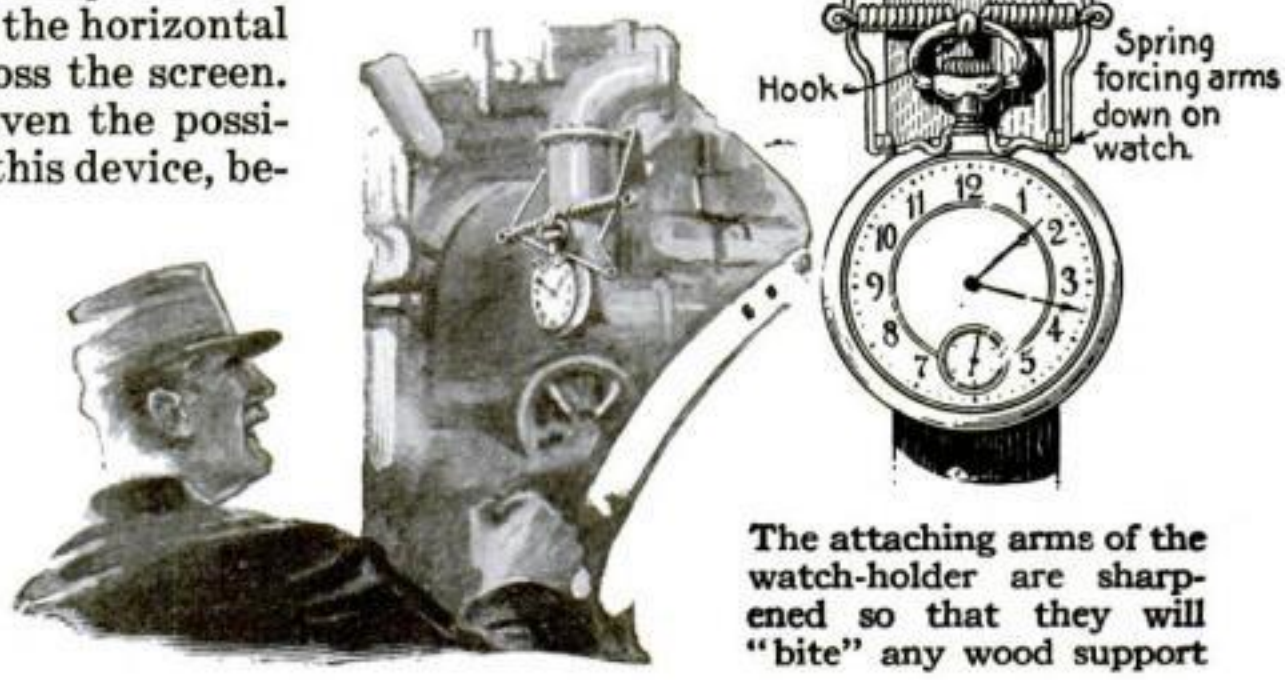
The Engineer's Watch-Holder — It Hangs the Watch in Any Position

TO the engineer, the most practical timepiece is one which can be used without loss of effort and time. For this reason, a watch-holder invented by Frank J. Ellis, of Philadelphia, should meet with his approval.

The device consists of a central bar on which two members are pivoted—one for attaching the device, and the other for holding the watch in the device. Both members are of spring wire, the attaching arms being sharpened at the points to grasp the support.

The watch-holding section is in one piece, the wire being coiled around the pivoting bar, forming a hook at the center of the bar and a U-shaped spring in the loop of the wire. In use, the ring of the watch catches over the hook and the stem of the watch slides into the U-shaped spring.

The tension of the various spring portions of the device hold it immovably in any position.



The attaching arms of the watch-holder are sharpened so that they will "bite" any wood support

Firing Bullets from a Slot at the End of a Shotgun

FROM the time British sportsmen learned that hitting flying things was entirely possible, there has been a hundred years of endeavor to make a shotgun fire its shot charges more compactly, to the end that the density of the "pattern" be sufficient to insure hits even at very long range.

Now comes an inventor with a device to make a shotgun spread its charge even more than the normal "cylinder" barrel, and not only to make it spread, but to produce a spread of a certain shape so as to increase the chances for a hit.

For war usage, this inventor has produced for the shotgun, a muzzle flattened horizontally, until it is nothing more than a slot of a width equal to the diameter of the buckshot to be used; and of course running horizontally as the gun is held by the shooter. The result, says the inventor, is a "pattern," made with twelve buckshot, fourteen inches high by eight feet wide at a distance of thirty yards. In other words, at this range the gun shoots a horizontal line of round bullets, not one of which is higher or lower than seven inches from the average, all traveling in a "line of skirmishers," eight feet wide. Were men charging the trench at yard intervals, which is not now true, three or four of them would be hit with a bullet each. The device can be applied to cannon also, the load being changed to a charge of loose leaden bullets and the muzzle flattened out to allow them to pass out in a horizontal line only.

For game shooting, what is needed is a little lever for quickly changing the horizontal position to a vertical one. Where the crossing duck or quail would have to run the gauntlet of a shot charge spread out, say, fifteen feet from east to west, the walked up game, rising suddenly, or the soaring duck, would call for a vertical position of the flattened muzzle.

The muzzle is flattened out so that the bullets issue in a horizontal line

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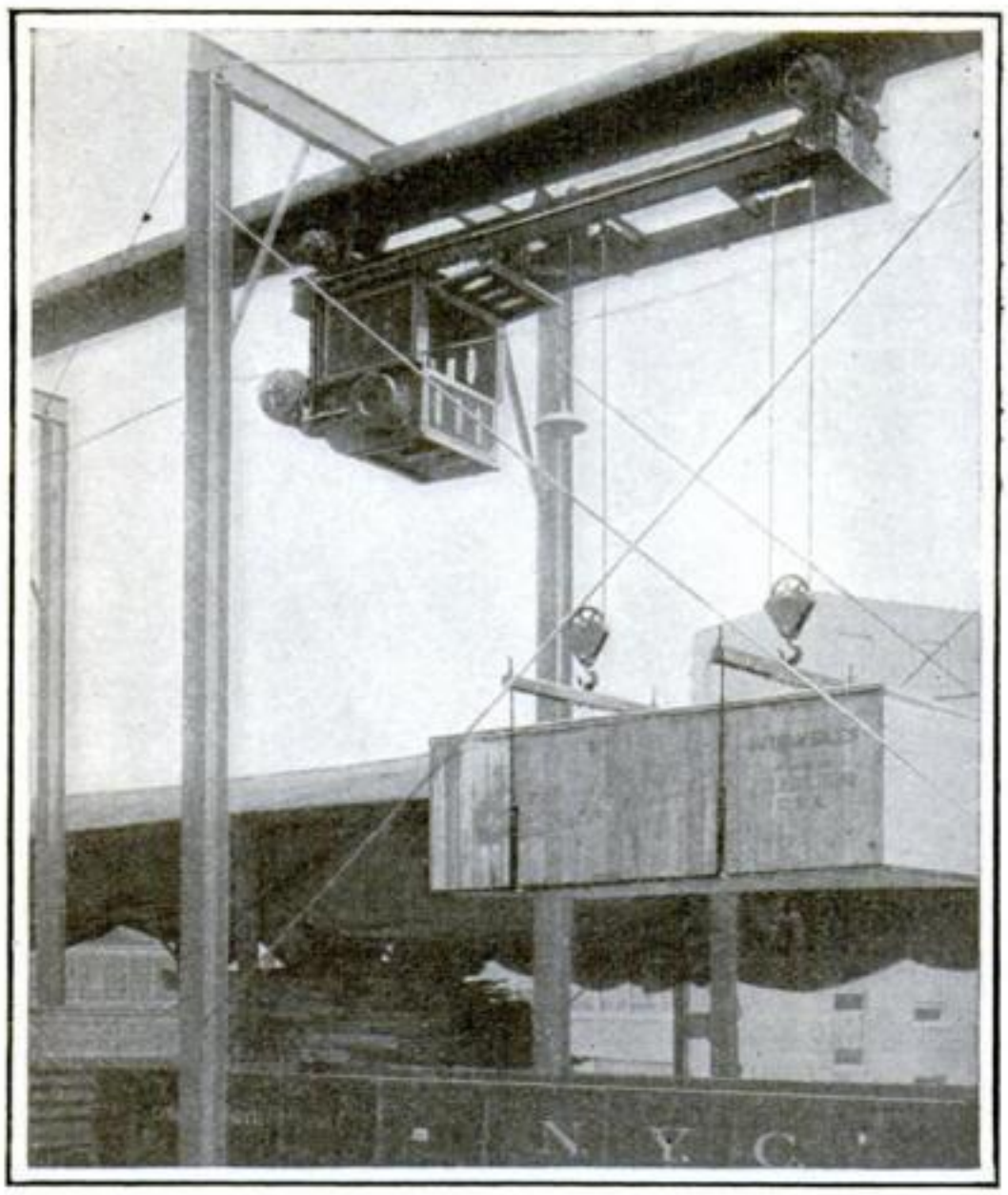
An Open Fireplace On the Veranda—What Next?

IN Los Angeles, Cal., the hottest day is followed by a cool evening. Hence the open-air fireplace is not so incongruous as it seems. It has been built into the corner of the veranda, the low walls of which are of cobblestones. The fireplace itself is of the same construction, with a brick chimney extending high enough into the air to conduct the smoke cloudward.

Here on cool evenings a bright log fire is built, which makes it possible for the residents to enjoy the out-of-doors.

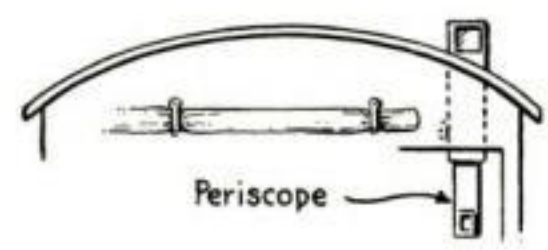
A cobblestone fireplace with a brick chimney built into the wall of the veranda is an attractive innovation



A one-man monorail for conveying boxed automobiles from the shipping room to the railroad siding

As Good as Ten Strong Men

CONVEYING systems which are very costly to instal, become good investments when there is a shortage of labor. An example of this is the long overhead monorail erected in a Toledo, Ohio, plant. The electrically operated crane is handled by but one man. It carries boxed automobiles from the plant to the flat cars on the siding, where the turning on of the electric motor lowers them into place. Formerly it took ten hands, with trucks and gangways, to accomplish the same labor. The work does not require a highly trained man. Awomancandoit.



The telescopic periscope for the engineer's cab is in two parts

A Periscope for the Engineer in His Cab

INVENTIONS previously used exclusively for war purposes, are now finding their way into industry. Even the submarine, associated with destruction, has something to contribute. For instance, why not periscopes for railway engineers? Why is it necessary for the engineer to lean out of his cab to see the track ahead of him, or the signal of the conductor or flagman in the rear of the train?

According to A. G. Spencer, of London, England, periscopes would be a great help to all locomotive engineers, eliminating much danger and inconvenience.

He has invented two periscopes which can be attached to an ordinary locomotive cab, to enable the engineer to obtain an unobstructed view of the track ahead and of his train in the rear. The periscopes are supported by rubber or other flexible means in brackets, so that they can be readily adjusted in position or turned about a vertical or horizontal axis. The space between the periscope and the roof of the cab is filled with rubber rings.

One of the periscopes is telescopic and is in two parts held together by a wing-nut and a bolt. It is provided with windows, a removable cover and projections which bear against the securing-clamps. The periscope may be of lazy-tongs type or otherwise adjustable in length, and the mirrors may be protected from smoke by a hood or casing.

So equipped, in an emergency, the engineer is able to see all that is necessary, without leaving his post at the throttle.

One Quick Pressure and the Cork Is Out

THE corkscrew has at last found a rival in the cork-puller, invented by John Sheridan, of San Francisco. Two thin scissors-like blades, having upwardly inclined serrations, are thrust into the cork body. When you close the blade handles, the serrated members open in wedge shape, and the cork can be pulled instantly. The inclined teeth draw the sides of the cork inward, making it smaller than the bottle-mouth, so that it is easily drawn out. The puller can be easily withdrawn by again separating the handles. It leaves only a small hole.

The blades are thrust into the cork, the handles pressed together and the cork extracted

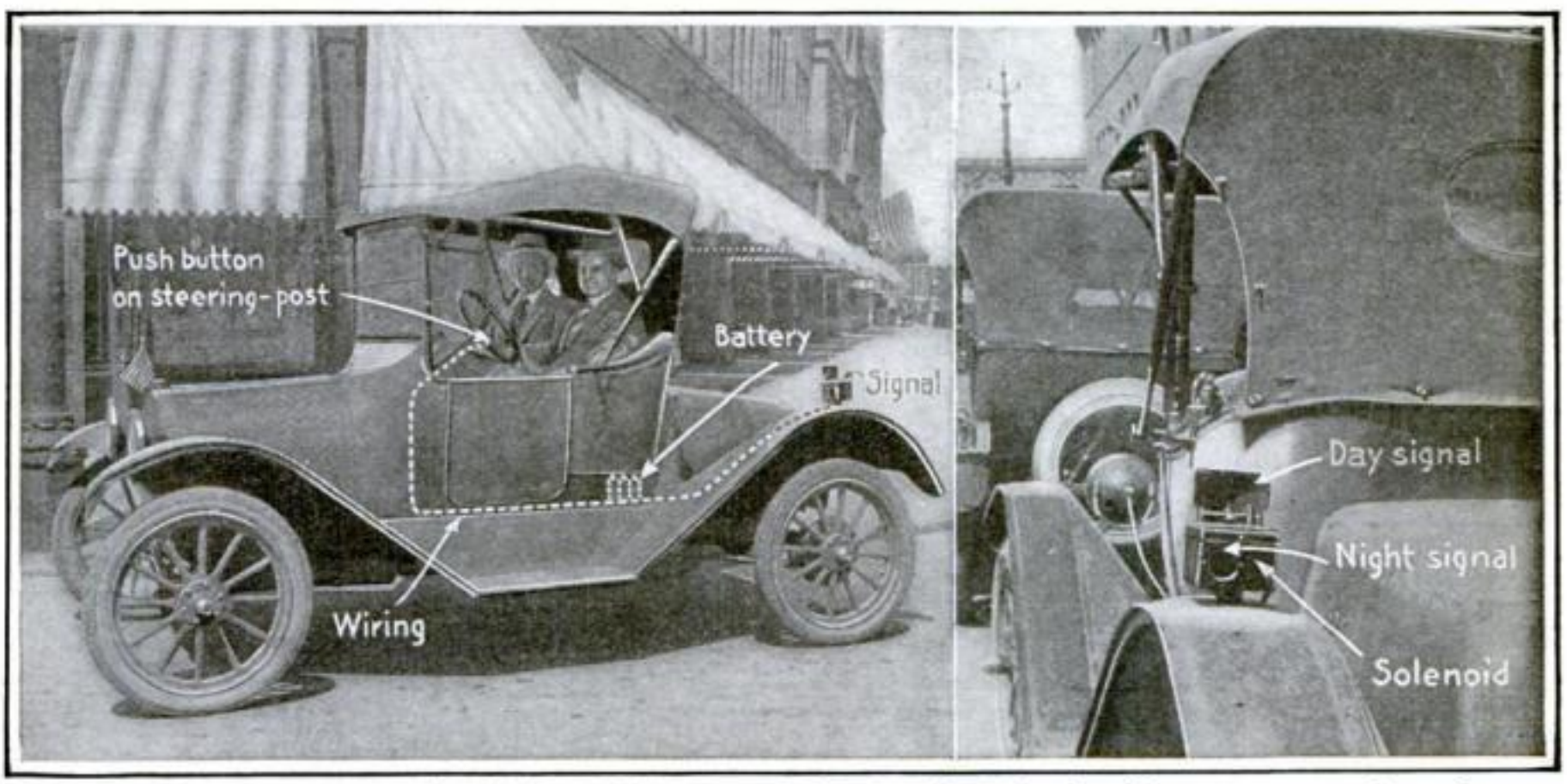
A New Automobile Signal. It is placed on the Left Rear Fender

A NEW signal, mounted on the rear fender of an automobile, flashes a red light by night and a red flag by day, to designate a change of course, with regard to direction. This does away with all the complications of oscillating hands or with the words "right or left", which are sometimes incorrectly manipulated by nervous drivers in emergencies.

The signal consists of a pressed-steel box with a red metal flag on the removable cover and a red bull's eye light at the rear. The device is mounted on the left rear fender and is operated by means of a push button.

In operation, the pushing of a button lights an electric lamp inside the box, and simultaneously energizes a solenoid which automatically causes the red flag on the top of the box to rise from a horizontal to a vertical position, transversely of the car.

The current for operating the signal may be had from a battery. The signal box is weatherproof, to prevent possible short-circuits, although these are further provided against by a fuse block and a ten-ampere fuse placed near the negative pole of the storage battery to prevent the solenoid from burning out.



A push button conveniently located on one of the steering wheel spiders, operates the red flag by day and flashes the red light by night. A battery supplies the necessary current

The chimney conducts the smoke upward and furnishes draft for the flames

Burning the Roots of Stumps Out of the Ground

IN wooded localities, farmers, who wish to remove the timber from their land in order to utilize the ground for raising crops, will appreciate a simple device for burning out the stumps and roots, invented by John H. Hempy, of New Hampshire, Ohio.

The inventor has made ingenious use of the well known fact that draft aids combustion, by constructing a conical chimney of sheet iron in several sections, which is so placed over the ignited stump that a strong draft is created. The air, rushing in from below, by its oxygen aids the process of combustion and keeps the fire burning briskly. After the lower part of the stump is burned away, the upper part settles into the fire and furnishes fuel to burn out the big roots near the surface.

The lowest section of the cone, with a diameter of thirty inches at the bottom, is made out of heavier sheet iron, while the two upper cones, which taper to a diameter of eight inches, may be made of ordinary stovepipe sheet iron.

The whole chimney is about six feet tall, but may be made higher if a stronger draft is desired.

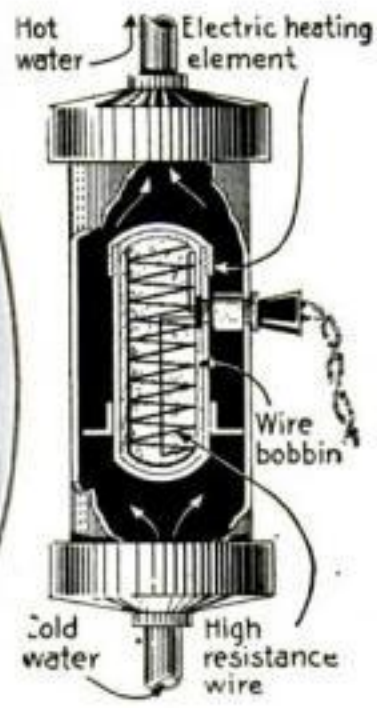
Turn the Switch and You'll Have All the Hot Water You Will Need

FREDERICK POOLE, of Kansas, has invented a water heater which operates electrically. It is even simpler than the gas heater.

An ordinary electric high-resistance heating element is placed in a large cylinder, about a foot in diameter. When water from the small pipe main enters so big a chamber, it travels very slowly. Therefore, when the current is turned through the heating element, the heat from its large radiating surface has an opportunity to make the water hot in so short a time that the method might well be classified as instantaneous.

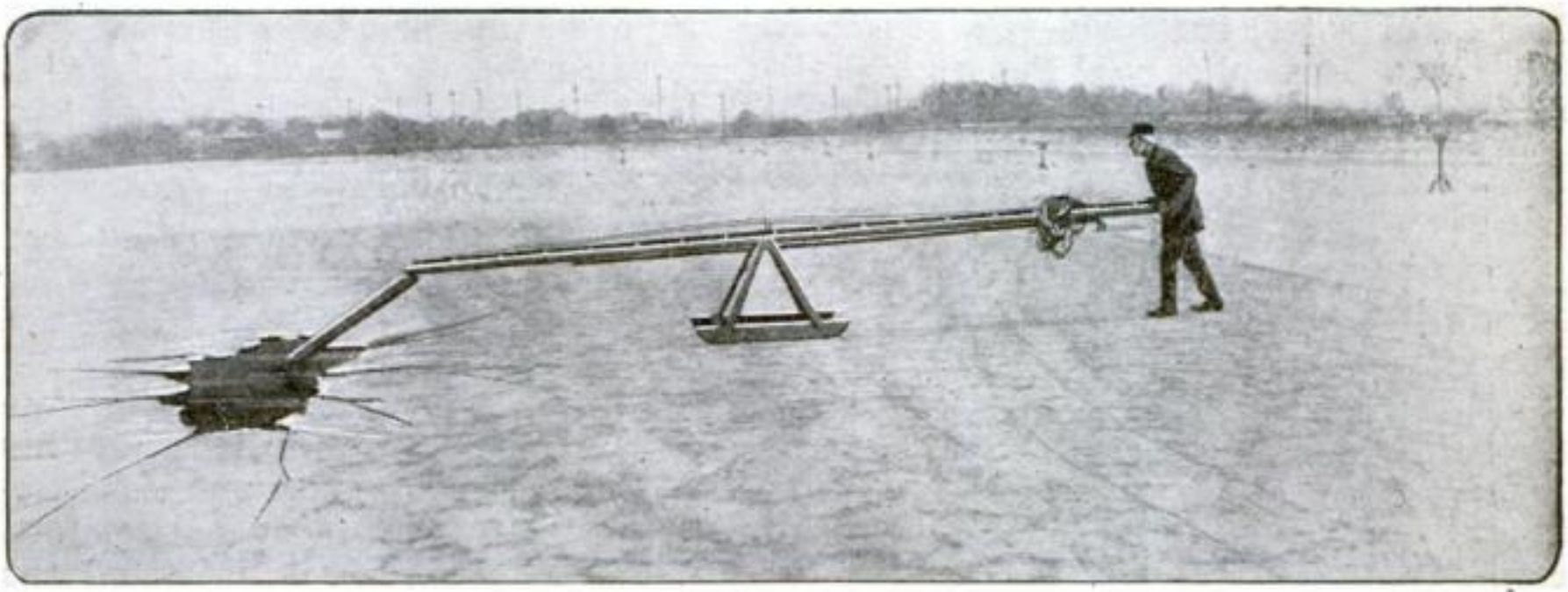
In any home having electricity, but where, without this attachment, it has always been necessary to light the kitchen range, and then to wait an hour or more in order to have hot water; the advantages of this quick method of preparing the morning bath, or, in case of emergency, of obtaining hot water at any hour of the night, will be obvious.

The water slowly passing around the large heating element in the metal cylinder is heated almost instantaneously



A Rescue Ladder for Treacherous Ice

By its use a skater who has fallen through thin ice can be saved without danger to the rescuers

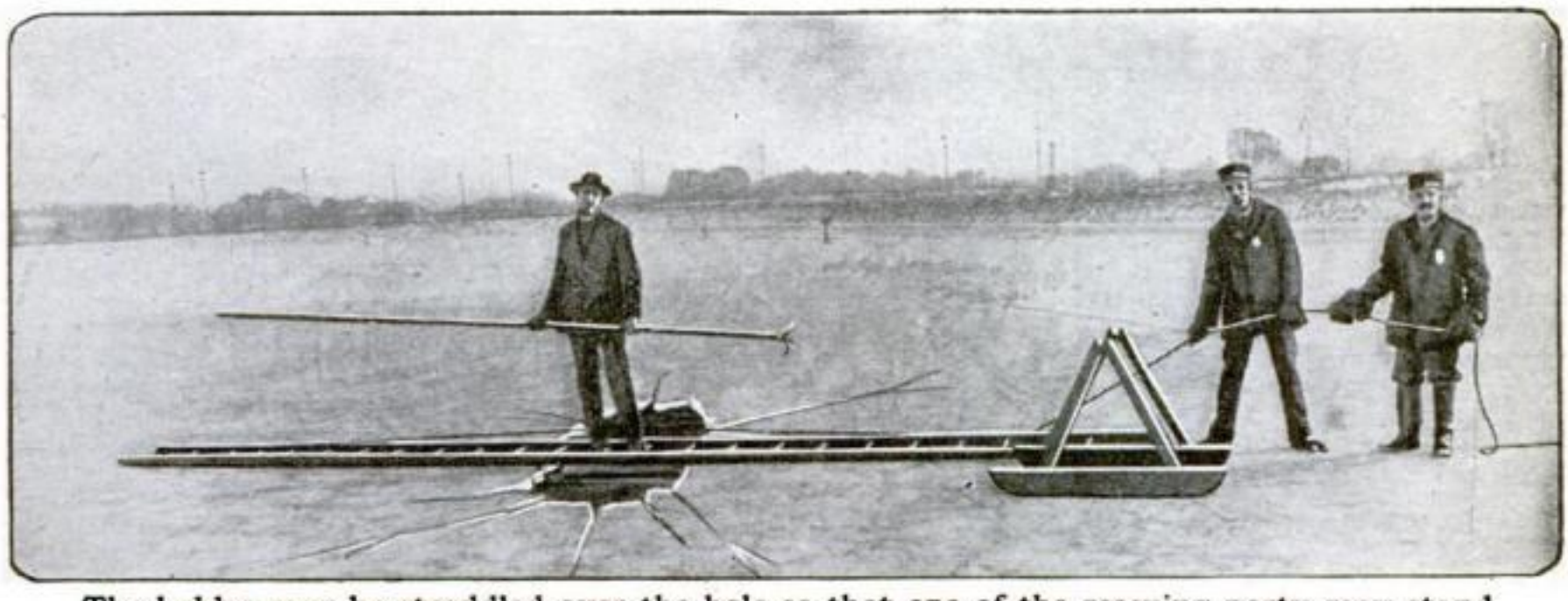


When the cry for help is heard the rescuing apparatus is pushed out until the pole and ladder can be grasped by the skater, who, with its aid is pulled safely to the shore

MAN through the ice! Wherever there is ice skating—and careless, overly venturesome skaters—that cry is sure to rend the air. If these persons are fortunate their calls for help will probably be answered by a rescue party with a rope. But due to the thinness of the ice where it has been broken through, rescue with a rope is a difficult matter and dangerous for the rescuers.

But, with the aid of a new apparatus invented by George Hanlon, foreman in the Department of Parks, of New York city, lying ready for use in an emergency, the chances of fatal consequences of the accident are greatly reduced. The device comprises an ordinary fifteen-foot ladder with a shorter ladder pivoted at one end and a pole mounted under the long ladder to hold the shorter one in place. This outfit is carried on a sled, on which the rescuers haul it to the spot where the skater has gone through. Obviously, the sled can be kept on the thicker ice ten feet away from the hole, while the pole is brought back to release the short ladder so that it drops into the hole. On this the person to be rescued can climb to safety.

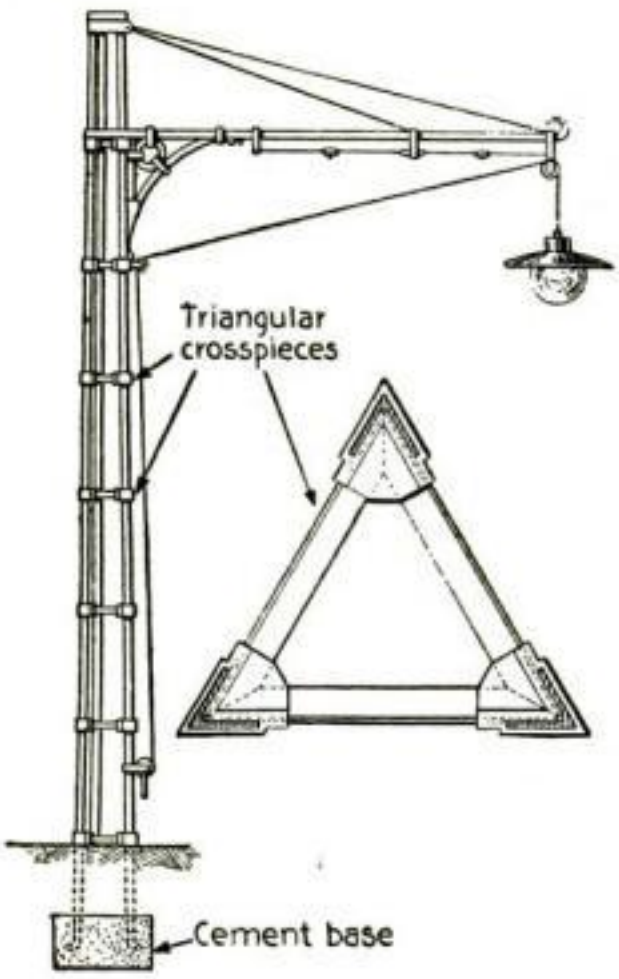
If the skater is not able to help himself, however, the big ladder can be removed from the sled and be slid over the ice until it straddles the hole. Someone will then walk out and with a grappling hook haul out the unfortunate one, lay him on the ladder and draw him to shore.



The ladder may be straddled over the hole so that one of the rescuing party may stand on it and locate the body with grappling hooks in case the skater has become helpless

Make the Collapsible Metal Telegraph Pole an Ornament—Not an Eyesore

AN innovation in telegraph pole construction has been introduced by a Belgian inventor, Oscar Valenne, of New York city. It requires no skilled workmen to erect it, for there are no intricate connections or adjustments to be made. The pole is shipped collapsed into a very small space; but it opens out into a structure of considerable height.



The triangular crossbars hold the telescoping sections of this pole absolutely rigid and upright

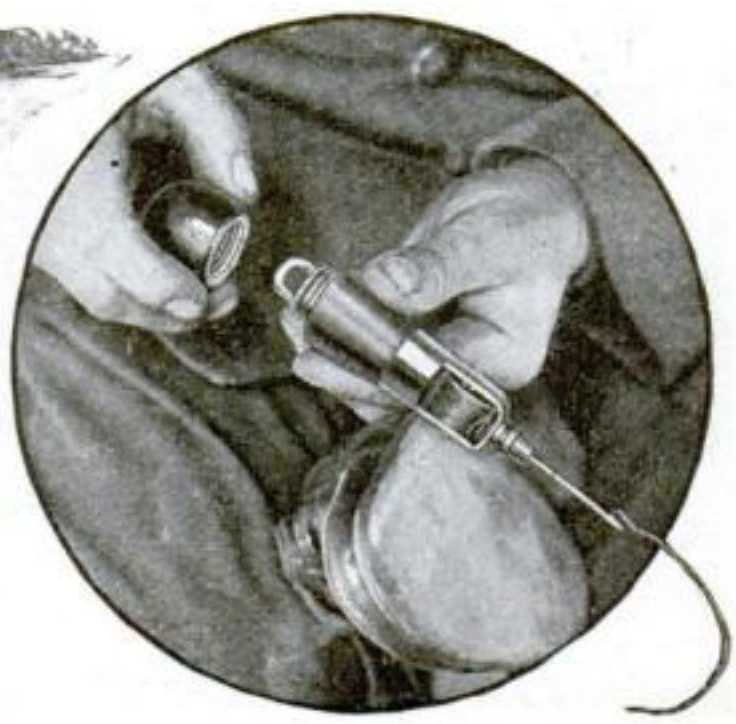
Three V-shaped irons are required to form the bodywork. These are held rigid by six triangular crossbars.

The laborers take the three separate V-pieces, run them through the slots at the corners of the largest triangular crossbar, and bury their ends in a block of newly made cement. The crossbar is slid into place, and the smallest one is temporarily placed on top. The top cross bar, or cap, is then removed and, beginning with the largest, the other crossbars are easily slid on.

The Soldier's Cobbler Kit. He Carries It in His Pocket

OUR soldier boys learn many things besides actual soldiering. When they return to their prosaic tasks after the war, there will be many a bank clerk, for instance, who will be eligible to join the cobblers' union. Of course there are shoe-repair stations all along the lines of battle, but so much depends upon the condition of his shoes and his consequent foot-comfort, that most of the boys carry the little cobbler's kit shown in the illustration, and make small repairs themselves.

The kit consists primarily of a hollow handle, the top of which unscrews to disclose the awl, screwdriver, cobblers' tacks, and other essentials for repair work. At the opposite end of the device is a spool of waxed twine, which threads immediately into the awl when the awl is screwed into place. When some other tool, such as a screwdriver or knifeblade, is to be used, it is screwed into place instead of the awl. In addition to his shoes the soldier may mend his torn leggings and his saddle traps.



The cobbler kit is used to mend leggings and saddle traps as well as to repair worn shoes

Making Paper and Cord from Marsh Grasses

Thousands of acres of hitherto worthless marshy land can be made to yield millions of dollars' worth of fiber and pulp for various uses

One million acres of this marshy land, overgrown with sedges and grasses, lie south of Savannah, Georgia. It will readily yield from one to two tons of fine dry pulp per acre

WHEN Pharaoh's daughter came across the baby Moses hidden among the bulrushes of the River Nile some three thousand years ago, he was tucked comfortably in a miniature ship made of sedges. In those days the common sedges growing in Egyptian marshes were used for cordage, mattings, sails and curtains, and the ancient vessels of bulrushes were made by binding and sewing them with the filaments of corded sedge.

To-day several large industries are facing a serious shortage in paper pulp, oakum, yarns, twine and kindred products. A decreasing supply of jute from India, sisal from Mexico, and Manila from the Philippines has sent prices skyward, and many manufacturers and publishers have been unable to stand the pinch and have failed. Were the paper and cordage producers as wise as Pharaoh's daughter and would they but go to the marshes for their future supply of raw material, they would find a sufficient quantity of fibers to meet the country's needs. We have been so busy since Pharaoh's time that we have forgotten all about our marsh sedges.

There are thousands—perhaps hundreds of thousands—of acres of marshy land which, from the standpoint of usefulness, might form one of the country's vast natural resources. Consider New Jersey and her marshes, the Virginia and North Carolina swamps and tidal districts, and the innumerable lakes with their fringes of rushes and sedges! If the ancient Egyptians made use of this raw material, why should not we of this age?

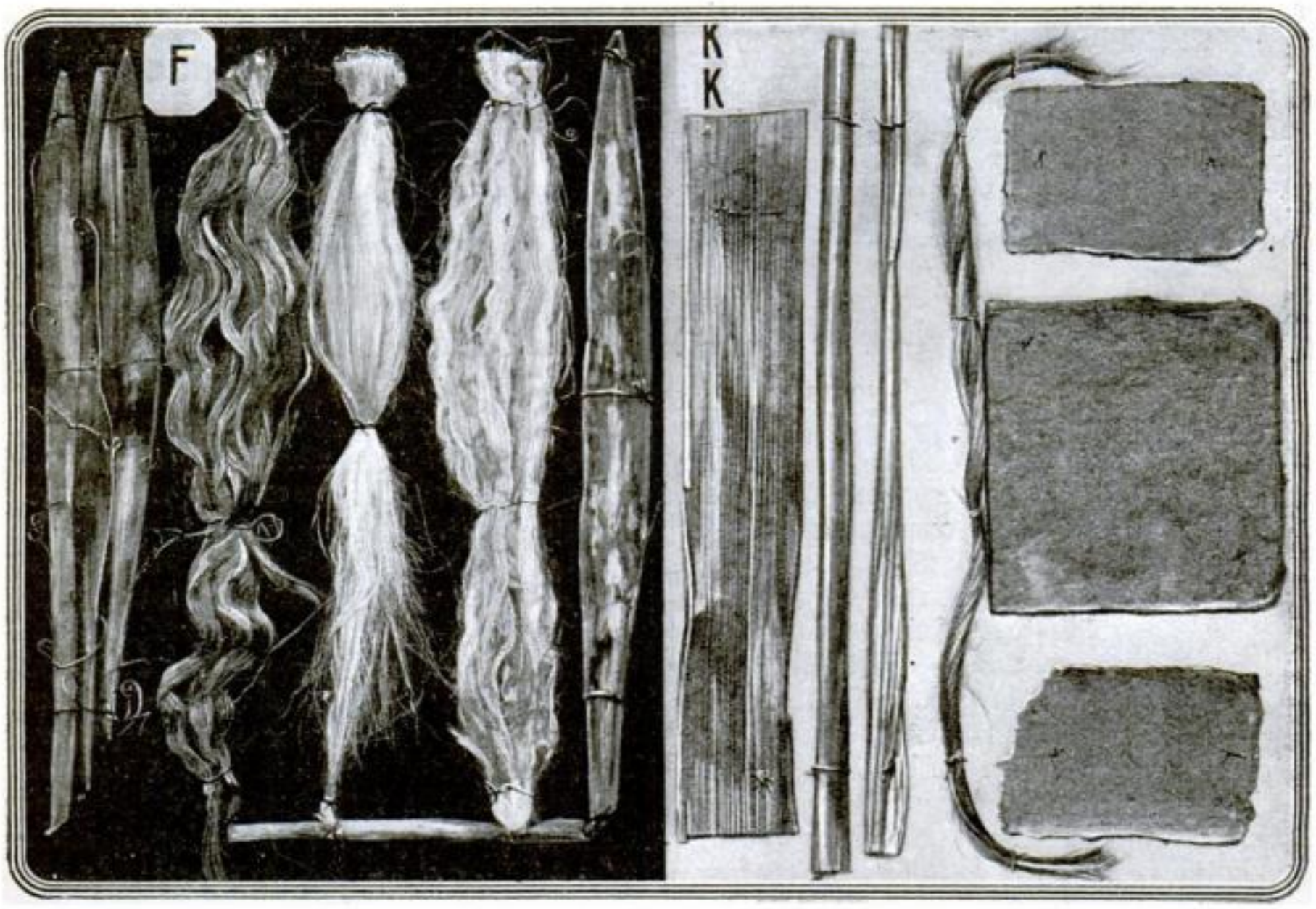
Thanks to the thirteen years of study and experimentation made by Col. R. A.

Marr, of Norfolk, Virginia, we are nearer to the utilization of waste areas of swampy ground than ever before. Colonel Marr has taken out patents on a chemical process for the treatment of sedges and grasses which makes them immediately available for industrial use. There are nearly two million tons of wild growth found within the borders of the United States and two hundred and fifty thousand tons within territory

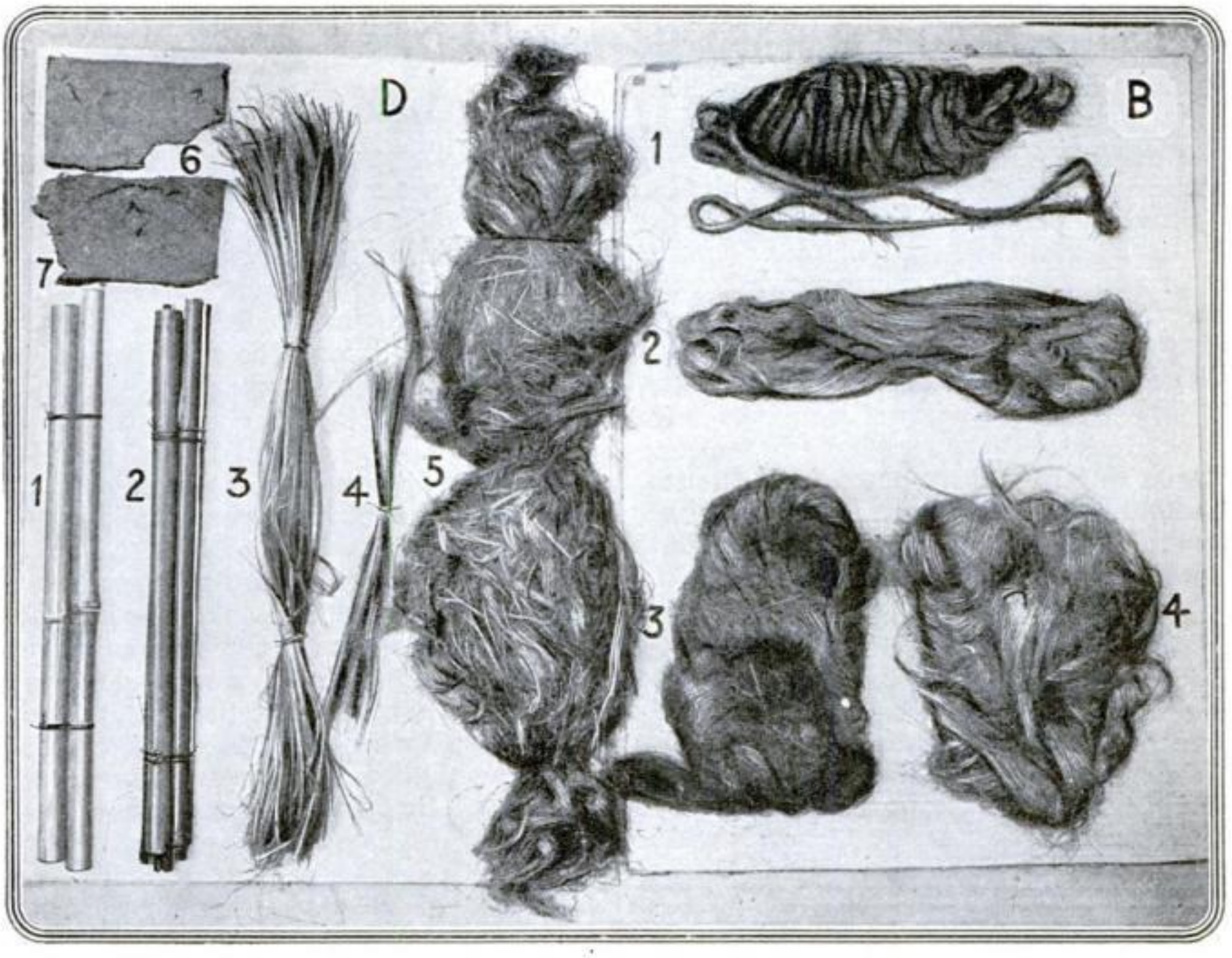
Col. R. A. Marr, at left, examining a bundle of oakum made from waste swamp grasses and weeds by his recently patented chemical process

contiguous to the United States, which can be chemically treated and made into strong paper and cordage.

There are three hundred thousand tons of an annual growth of fresh and salt water sedges and rushes which can be made into substitute textile fibers for jute and other rope materials. This raw material works easily with jute machinery and it can be used in whole or in part for cotton bagging, light oakums, roofing



Experiments with bear grass and banana. At left, indicated by F, appears the grass in its natural state and in its shredded or spinning state, after chemical treatment. In KK is shown the five steps in the making of banana pulp, from the raw article to the finished product

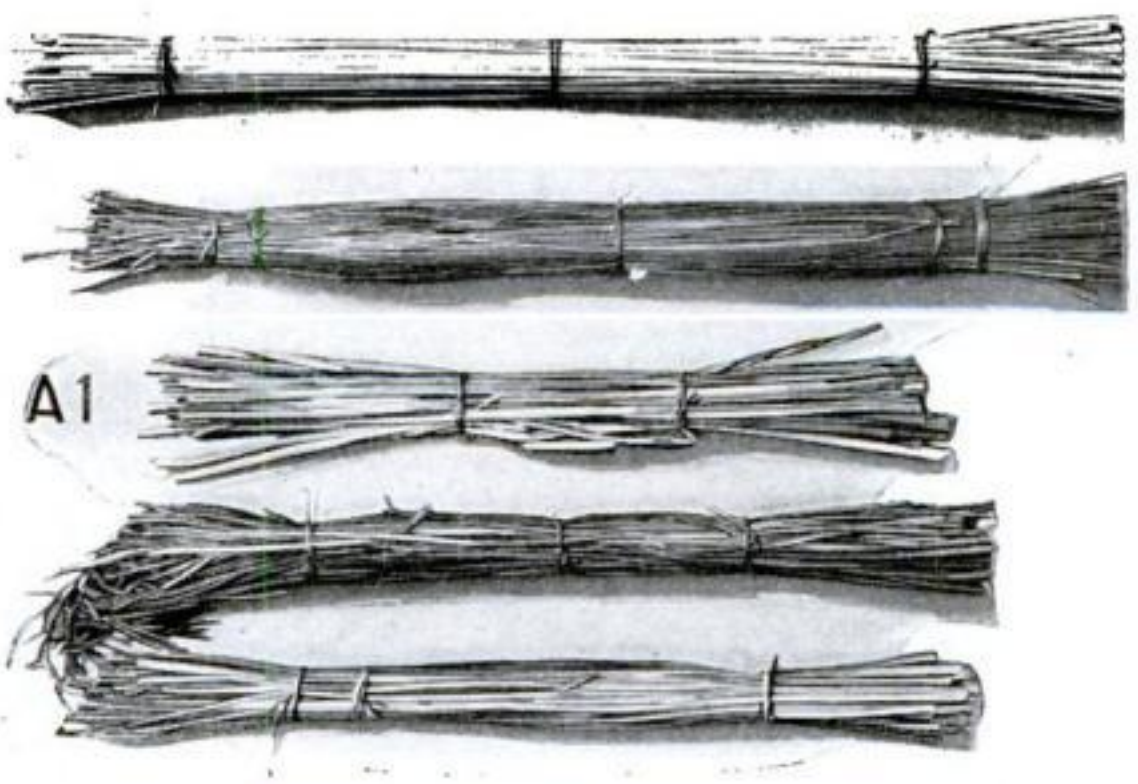


The Different Stages in the Treatment of Reeds and Canes

At left above, indicated by D: 1. Raw cane material. 2. After treatment and ready for rolls and picker. 3. After going through picker. 4. May be used for brush. 5. Bagging for cotton, peanuts, grain and potatoes. 6. Can be used as roofing felt. 7. Fine clean pulp stock. In B above: 1. Bear grass made into cellulose wool. 2. Oakum of good quality. 3. Sedge fiber rove for bagging and pads. 4. Sedge fiber used as plumber's oakum

felts and papers. It is very durable.

Canes, reeds or bamboo, of which there is an annual available supply of five hundred thousand tons, can be used for binder twine, bagging mixtures, coarse sacking, strong cordage, paper pulps, oakums, and strong fibers. Two hundred thousand tons of yucca can be used as a substitute for sisal and Manila and for cordage, twines, yarns, strong papers and paper pulp. There is also an annual supply of two hundred and fifty thousand tons of banana, pita, pineapple and palm which can be utilized for cordage, twines, cellulose, wool weaves, linen and cotton rag pulp.



A1 above shows five different kinds of salt and fresh water sedges and rushes which can be made into fiber or pulp. The ancient Egyptians found use for them

These

plants are wild grown upon waste land and are annually reproduced every six months in some localities. The yield is from one to two tons of dry pulp on an average per acre.

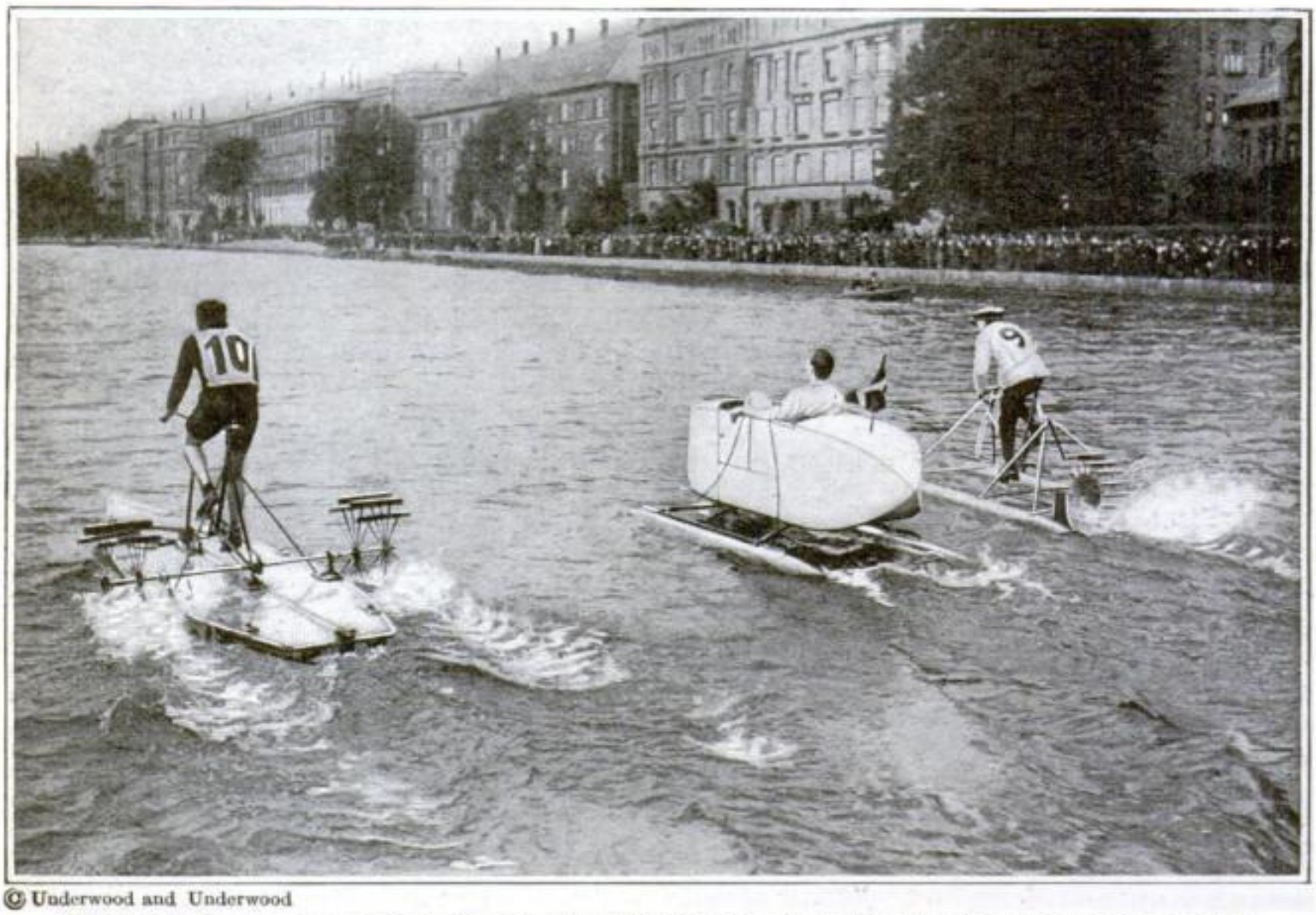
By the processes and methods patented by Col. Marr, the yields of pulp for paper purposes and the yields of fiber for bagging and other cordage are much beyond anything heretofore obtained and recorded. By using either zinc sulphate or chloride, his processes render the gums, resinous matter, wax and fats, the silica and the cementitious carbohydrates soluble in water. In five hours from the raw material to the finished product, oak, beech, birch, maples, gums and poplars yield in available pulp an average of eighty-five per cent of the weight of the wood. It is not necessary to chop wood as fine for reduction by his processes as with processes now in use.

To possess commercial value a fiber must be available in large quantity, the supply must be more or less constant, the product must be readily marketed, and it must be cheap. The fibers obtained from marsh growths, by the processes patented by Col. Marr, fulfill all these requirements.

What Is It? A Naval Architectural Puzzle

AT the Water Sports Carnival held annually at Copenhagen, Denmark, any inventor can demonstrate his devices, provided they are in tangible shape and have something to do with sport or locomotion in water. The contests are usually staged on Sortedamsöen.

In the scene shown, the catamaran with a rear paddlewheel, at the right, is an old contraption dating back to the first bicycle days. The similar craft to the left, is fitted with a heavy keel to steady it, and the float is hollow and very shallow. It obeys the rudder better than the catamaran. Mystery centers in the queer tub in the middle with its ambitious streamline contours and its electric wires dangling at the side. Its wake does not indicate great speed, and the flag does not seem to unfurl in the breeze. It appears that the pilot has storage batteries on board and that he is driving two motors in watertight compartments in the pontoon, which motors, in turn, drive two Archimedian screws or similar contrivances to take in water and to expel it.



Denmark has many good mechanics who think more of having fun in some new way with their contraptions than of making money by exploiting their inventiveness commercially

What's in a Name? In "German Silver," for Instance

GERMAN silver is manufactured in three general ways. It is composed of nickel, copper and zinc in varying proportions. The German method is to melt all the copper to be used in the mixture, and two-thirds of the nickel and zinc in a graphite crucible and then add the rest of the nickel and zinc. In the English method the copper, nickel and zinc are melted all at one time, then more copper and zinc are added. Should the metal appear porous, a fireclay pipe containing pitch is pushed into the metal mixture to deoxidize it. There are several American methods. One is to melt a copper-nickel alloy and then gradually add the preheated zinc. In another method monel metal is used as a base.

Business is good, thank you, in this the narrowest of stores. Can you see the store?

You Can Attach This Humidifier to Your Radiator

A HUMIDIFIER is now manufactured which may be quickly attached to a flat or round top steam radiator. Two soft pliable wires are passed between the radiator coils to the back of the humidifier, where they are tightly wound round two buttons. This enables the moistening device to be attached as firmly as if it formed part of the radiator. When it is desired to remove the water from the humidifier it is only necessary to unloosen the wires from the buttons, then the device can be carried to another room for cleaning. When the radiator is not being used during the summer months, the water in the humidifier may be removed and the box-life part be utilized as a temporary resting place for flowers until they can be planted.

The humidifier is made fast to the radiator by two wires passing between the hot-water coils

The Narrowest Store. It Is Only Six Feet Wide

GROUND space must be extremely valuable in Corry, Pa., judging from the manner in which the owner of a six-foot strip between the right of way of a railroad and the building line of one of the streets of Corry utilized his property. He erected a brick building, six feet wide and about seventy-five feet long, and installed in the narrow building a lunch room at one end, and a cigar, candy and ice cream counter at the other. The queer structure caused considerable amusement at first, but it proved a good investment. When the railroad encroached about two feet upon the ground, it had to move back.

The Camera-Gun. Photograph Your Bird Before You Shoot Him

THE expression, "take a snap-shot," becomes very real to the photographer who uses a new camera support recently invented by George Lansis. The support is made in the form of a gun. The camera is attached to the barrel in such a manner that in sighting the object to be photographed, just as a target is sighted with a rifle, the exposure is made by pulling a trigger.

The camera may be attached to a real gun instead of to the support which looks like one. This arrangement will enable a hunter to photograph any bird or animal just before it falls a victim to his gun. Or, if the camera is equipped with a quick-action lens, the bird might be photographed at the instant it is shot, to test the hunter's accuracy.

With this device naturalists could obtain a photograph of the animal and the animal itself within the space of a few seconds.

The camera may be attached to a real or dummy gun

The Wigs of the Future May Be Made of Glass

IN Venice they are spinning glass for commercial uses, converting it into glass cotton and glass wool pressed into sheets or pads. Although the principal use of the product at present, is for insulation, we have the word of the Italian makers, that it serves admirably for making artificial hair, wigs, perukes, doll's hair, Santa Claus beards and other hirsute adornments. The processes of manufacture are simple. Solid glass rods, made of pure American soda that contains no adulteration of lead or other metal, are worked into fluff under a Bunsen burner and blowpipe. A bicycle wheel, minus the tire, winds up the threads. If the threads are sufficiently fine they curl and fluff out like wool.

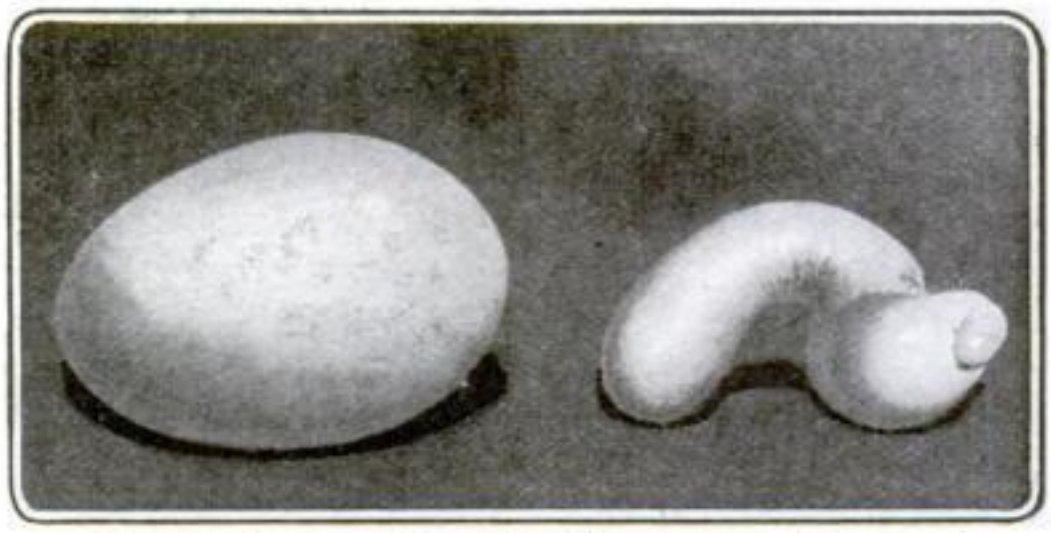
The product is now marketed in three forms—glass cotton, glass wool, and in sheets about one-half inch thick which resemble white felt pads. In the last form mentioned, it may be used to make separators for accumulators of electricity.

The Slacker Hen—She Lays Curious but Uneatable Eggs

THERE is only one thing to do for the hen who lays such eggs as the freak formation shown in the accompanying photograph. It is a case for the application of the verdict rendered in the old college song, "Chop Her Head Off—Short!"

The freak has two decided curves and at first glance looks almost like a snail. It was laid in the same nest in which a dozen or more small eggs, like birds' eggs, had been found during the spring and summer. These tiny eggs contained no yolks at all. It is probable that the curiously formed egg shown here is also yolkless.

There are two reasons for passing the death sentence upon the hen that laid the egg. One is that slackers in the poultry yard during war-time are not to be tolerated under any circumstances; the other is that the hen is unhealthy and is probably suffering from some internal disturbance.



The freak egg placed beside an egg of natural size and shape for the sake of comparison

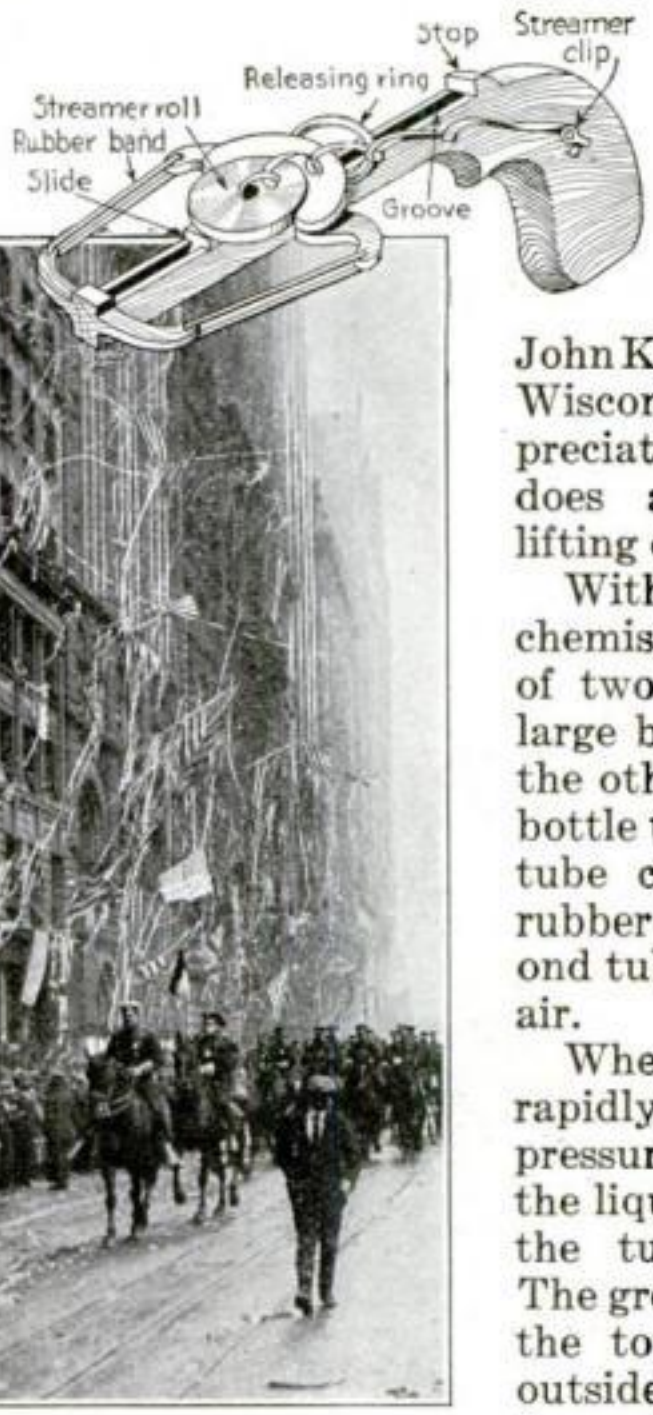
A Sausage Dealer Out-Pigs the Pig in Hungry Berlin

HAVING tried a substitute for almost everything, the Germans, we are told, are stopping short of nothing in their attempt to make certain new foods take the place of those made scarce by the war. The latest report says that a sausage dealer in Berlin has been fined $500 for selling sausage made of macerated rubber, finely ground hair and gelatin. His camouflage product contained no liver, no flesh foods and no fats. At that, it was probably as digestible as some so-called sausage on sale in this country.

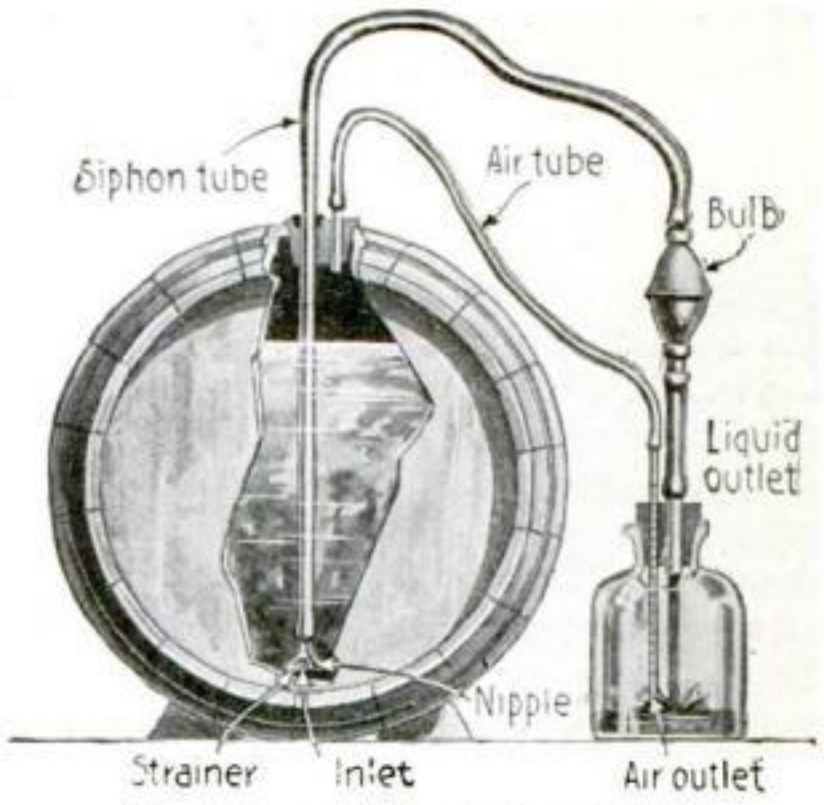
Shoot Your Streamers with a Gun and Save Your Arm

A WOODEN gun, with a stock and barrel not unlike the first archer's pieces ever used, but withal an improvement on the schoolboy's "bean shooter," has been invented by Jose L. Castillo, of San Francisco, California, for hurling long streamers or serpentines over the heads of people at carnivals and outdoor festivals. Elastic bands take the place of gunpowder and the barrel is nothing more than a slide, traveling in a groove. To shoot the streamer, you place it against the slide and fasten the hook or trigger over a stop, which takes the place of a trigger. Elastic bands afford the tension and the instant the hook is released the slide with its streamer shoots forward, the slide striking a forward stop and the streamer continuing on until it breaks. Before firing, the streamer is fastened to a clip on the stock.

It is well to unwind the streamer a few inches before it is fired, to prevent it from breaking off short.



Every streamer would sail far and swiftly if expelled from a gun



The stream of liquid is siphoned from one bottle to another by pressure on the rubber bulb

Making the Siphon Empty Heavy Bottles

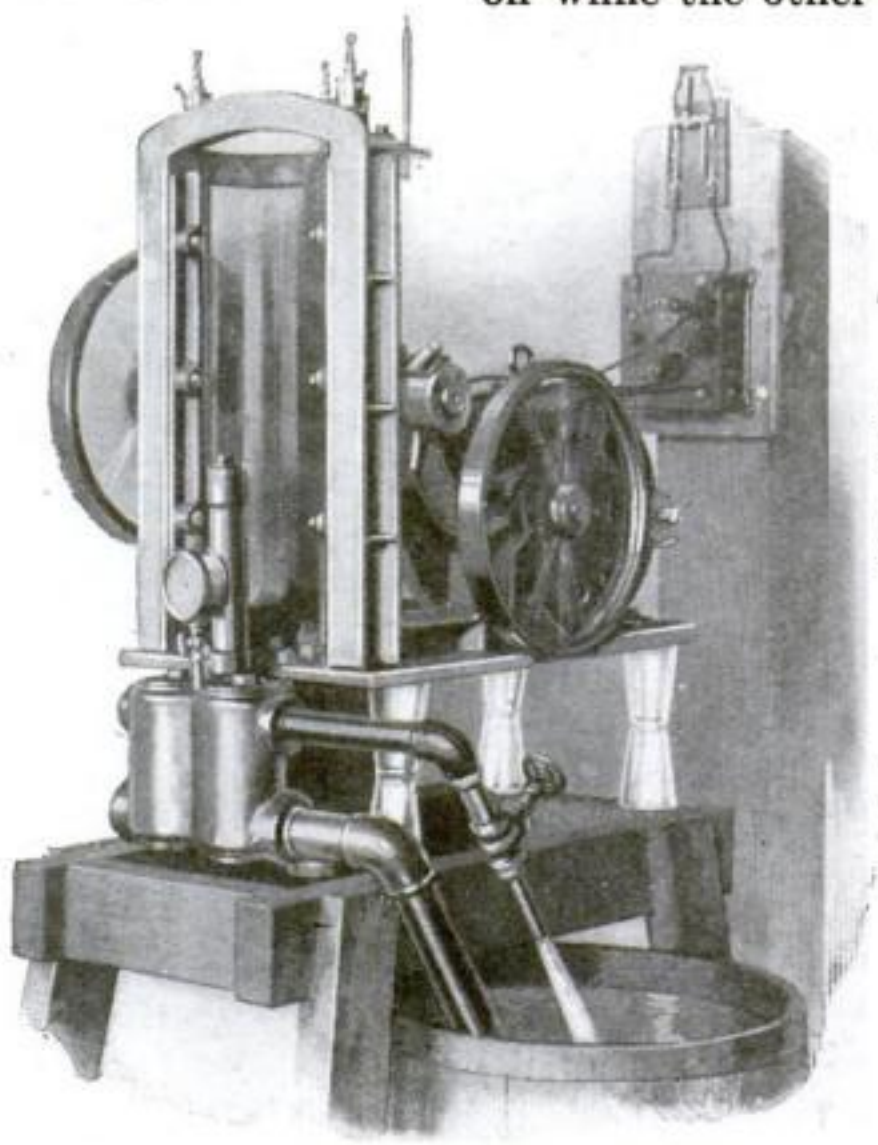
IN factories where large amounts of liquids are handled, the siphon, devised by Charles Barrow and John Karpen, of Racine, Wisconsin, will be appreciated because it does away with the lifting of heavy bottles.

With his siphon, the chemist inserts the ends of two tubes into the large bottle and places the other ends into the bottle to be filled. One tube contains a large rubber bulb. The second tube contains only air.

When the bulb is rapidly compressed, the pressure on the top of the liquid in the end of the tube is reduced. The greater pressure on the top of the liquid outside of the tube forces it toward the inside, then up and into the smaller flask.

How a Photograph Can Show the Efficiency of a Pumping Machine

ONE of the finest demonstrations of correct mechanical principles in a machine is given in the accompanying illustration. Although the pump and motor are on a precarious mounting of eight glass tumblers, and although the outfit is pumping away at full speed, a photograph of eight minutes exposure failed to detect the slightest vibration. To the experienced engineer, one look at the picture would convince him of the pump's high efficiency.

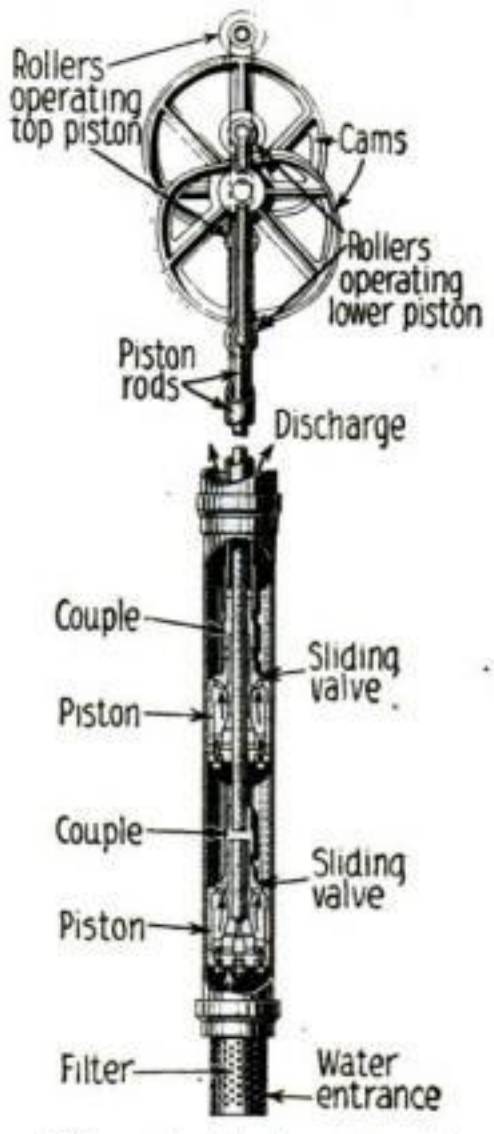


The almost entire lack of vibration or jar is a good indication that this non-pulsating pump has a wonderfully high efficiency

And that is what the manufacturers wanted to show. The pump, which is non-pulsating, has been designed on a new mechanical basis. High speed pumps that are seen nowadays are crank driven. A crank drives the pump pistons fast at the middle of the stroke, and then slows them down at the end. The result is a violently pulsating stream, the reaction of which, especially if the water is pumped to any height, is enough seriously to jar the pump.

As shown at the right, it has two pistons in the same cylinder, so reciprocated by cams on the pump frame work that a solid, uniform flow is produced. One piston sucks and lifts the water at constant speed during the largest part of its pumping stroke. Over the remainder of its stroke, the same piston gradually trails the load off while the other piston is assuming it. The combined flow is thus always uniform and equal to the rated amount.

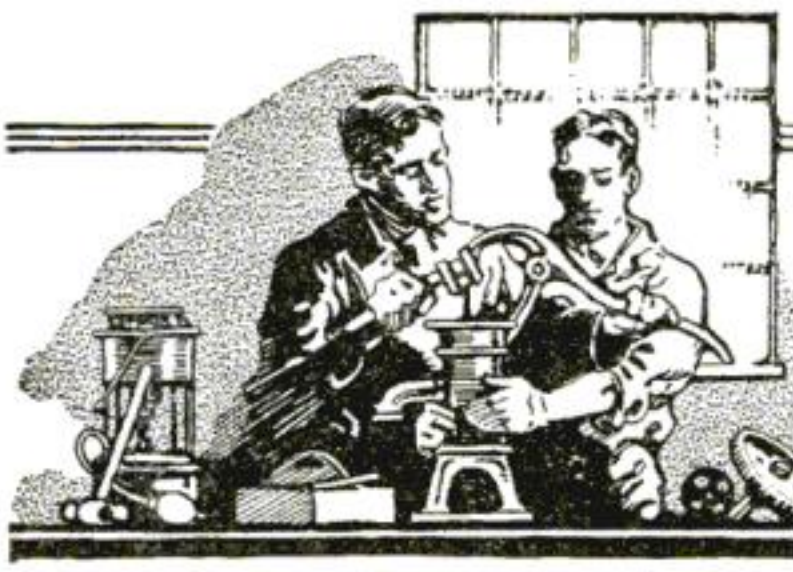
The continual stopping and starting of the column of water, which causes a great waste of power and which is hard on the machinery, is thus replaced by a uniform stream which doesn't as much as knock over the lead pencil at the top of the machine. Compared with other pumps, the one described here is said to effect a saving of eighty per cent of power and fuel.



The principal parts of the pump and their relation to one another

There Has Been a Shortage of Coal in Italy Ever Since 1913

ITALY is so pressed for coal that gas engineers are compelled to employ substitutes. Since the war with Turkey, in 1913, there has been a serious shortage of fuel in the country. Today, coal costs seven times as much as it did a few years ago. Yet, strange to say, the price of coke has not risen in proportion to coal. At the middle of 1916, coke was costing but two and a half times as much as before the war. Private gas works, which have made pre-war contracts with the municipal authorities, are in a precarious condition and are running at enormous losses, due to the exorbitant prices they are obliged to pay.

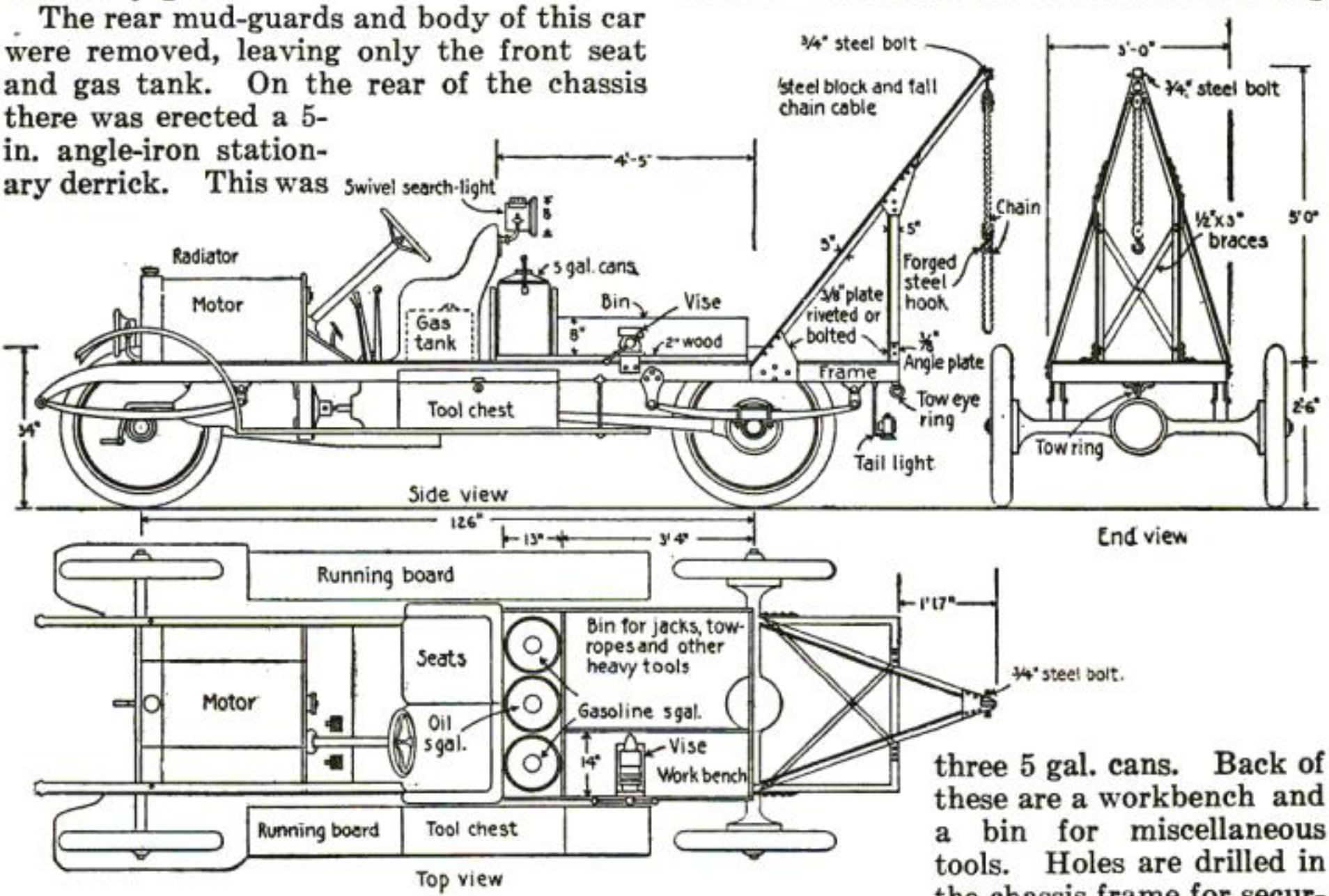


FOR PRACTICAL WORKERS

Making an Automobile Serve as a Wrecker

IT is almost a necessity for every garage to have a road repair automobile, and one with a lifting crane is most desirable. The one illustrated was built from an old discarded pleasure car, having a 40-horsepower engine and a three-speed sliding gear with a leather cone clutch. Generally an old car is best for the purpose, providing it is mechanically good.

The rear mud-guards and body of this car were removed, leaving only the front seat and gas tank. On the rear of the chassis there was erected a 5-in. angle-iron stationary derrick. This was reinforced and the derrick was held to the chassis frame with ⅜-in. plates. A forged steel eyelet having a 2-in. inside diameter hole was attached to the upper end of the angle-iron with rivets. To the eyelet was hung a hoisting block and tackle, the lower member being equipped with a 3-in. forged steel hook. This is for the purpose of raising the axles and frame of the broken automobile sufficiently to quickly assemble new parts. Back of the automobile seat is fitted a 2-in. oak platform 4 ft. 5 in. long and having a width the same as the original body. On top of this platform are built 8-in. compartments with reinforced iron corner braces for holding three 5 gal. cans. Back of these are a workbench and a bin for miscellaneous tools. Holes are drilled in the chassis frame for securing a heavy 6-in. vise, which is a very necessary tool for a road repair bench.



Details of the framework for a crane to be attached to the rear end of a chassis frame and workbench to make a wrecking truck

Attached to the extreme end of the chassis frame is a ½ by 1¼ clamp through which is

placed a 3-in. forged steel ring for towing purposes. From the lighting system of the automobile an 8-in. swiveled head lamp was attached to the rear of the seat. Whether electricity or acetylene gas is used this arrangement serves the purpose excellently when making night repairs. The lamp may be turned directly on the work.

A large tool box is built on the left running board. In this all necessary bench tools are carried, including hammers, wrenches, files, hacksaws, hand drills, gasoline torch and soldering outfit, a set of dry batteries, wire tape and assortment of bolts, nuts and washers, from ½ to 6-in. tire repair outfit, gasoline priming can, spark plug kit, etc. Back of the seat a tarpaulin is kept. A small emery wheel grinder may be geared from the flywheel by a friction pulley and a ⅜-in. countershaft run parallel with the frame to the workbench.—P. P. AVERY.

A Guard to Prevent You from Dipping Your Pen Too Deep in the Ink

CUT out a small square or circle of mica and slip it over your favorite penholder about ¼ in. from the pen point. A small brad on each side will hold the mica extension in place. This arrangement will serve as an excellent ink gage when dipping the point in the bottle and also as a guard against ink stains. The mica square will prevent the pen from being dipped in too far. It does not obstruct your view of the writing; you can see through the mica. Should it become stained, washing it in a little water will immediately clear it. —CLARENCE T. HUBBARD.

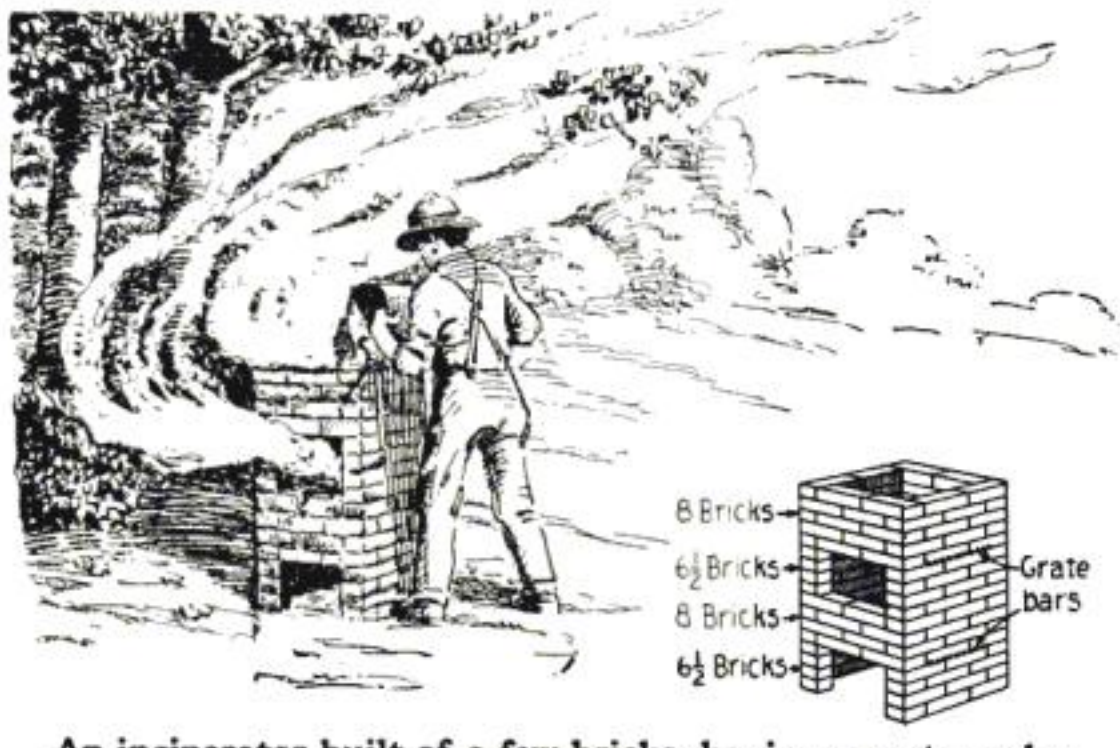
A square of mica protects your fingers from ink stains

A Liquid to Clean Silverware Without Damage

WHEN using silver polishes, it should be remembered that some silver is always removed in the cleaning process. For this reason liquid polish is sometimes preferred to the ordinary powder, as it removes the tarnish without scratching, and at the same time leaves a bright lustre. A very satisfactory liquid polish can be prepared by mixing five parts of aqua ammonia, 20 parts sodium hyposulphite, and ten parts of ammonium chloride in 200 parts of water. The greatest distributor of silverware in New York city recommends the use of sodium hyposulphite in water.

An Easily Constructed Brick Incinerator for Garbage

AN effective, cheap incinerator for a suburban home can be made from the materials listed herein. First lay six and one-half bricks on a smooth base, beginning on one side with half a brick placed next to a whole brick; then take a whole brick and lay it crossing the end of the last one. Continue this until the full six and one-half bricks have been used. The second, third and fourth rows are laid in the same manner, lapping the joints. When the fourth tier is completed lay on a good ½-in. coat of mortar and imbed in it ten iron bars each 21 in. long and about ¼ in. in diameter (or the flat kind) laying two in front over the bricks to support the next tier, spacing them equally. Another complete tier of eight bricks is then laid, starting with six and one-half



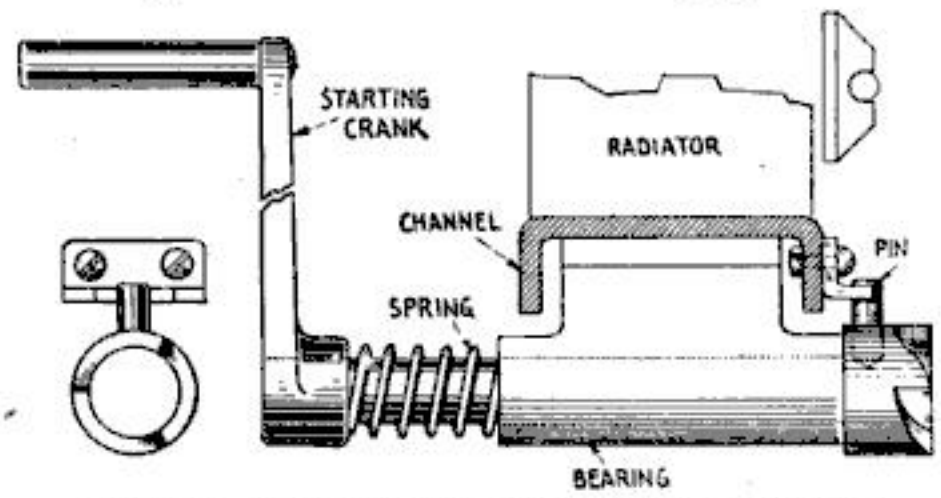
An incinerator built of a few bricks, having a grate under the garbage grate for drying and burning the refuse matter

bricks to make the front opening. On top of this lay ten more bars imbedded in the mortar, then lay five layers of brick, finishing the top by rounding it off with mortar.

When this is completed the incinerator will have a fire grate below and another grate above entirely surrounded with bricks. The second grate forms a receptacle for garbage. The mortar should be made of slacked lime and sharp sand.—RONALD F. RIBLET.

Holder for the Starting Crank of an Automobile

ON some older types of automobiles no provision was made for securing the starting crank when it was disengaged. The



The pin on the jaw-clutch that slips into a notch for holding crank in an upright position

arrangement shown herewith for holding the starting crank is easy to make and apply and will be found very effective. The sketch shows the usual jaw-clutch shaft held in a bearing fastened to the underside of the radiator channel.

The crank-holding device consists of a hardened steel pin driven in the large part of the clutch shaft so that it will engage the slot plate when the spring forces the shaft outward. When cranking the motor the pin clears the slot plate. The pin is either a drive fit in the clutch shaft or is threaded. If the shaft is hardened it will be necessary to anneal it before trying to drill the holes.—W. BURR BENNETT.

Cut Your Ice Silently and Easily With a Needle and Thimble

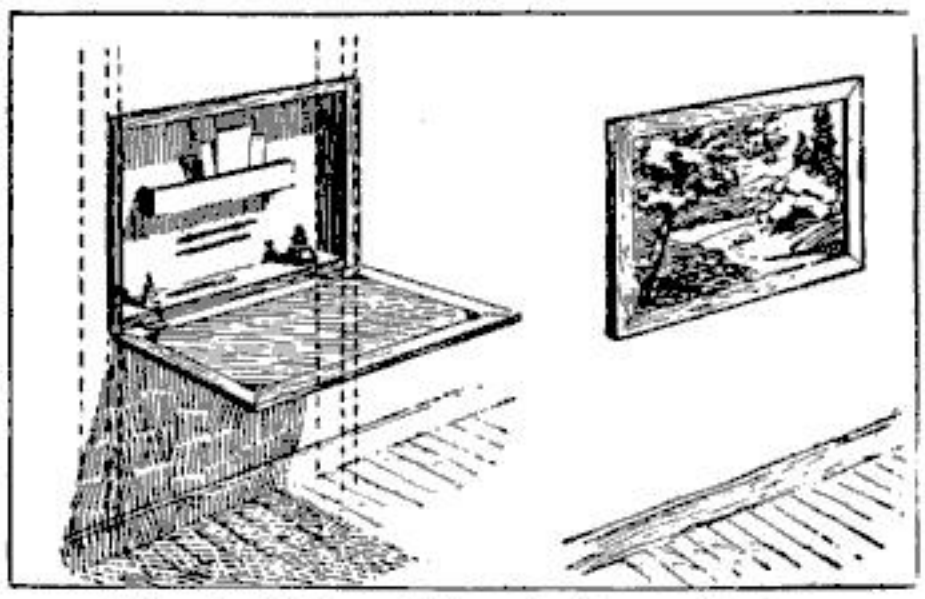
A BLOCK of ice can be split into small pieces in a very short time by the use of a needle and thimble, without the trouble of putting the ice in a bag and pounding it or the muss attending the shaving or picking process.

A rather coarse needle of the variety used for hand sewing, or a small darning needle, and a thimble are the only tools required.

Hold the needle between the thumb and index finger of the right hand, and with the thimble on the second finger of the same hand press the needle firmly and steadily into the ice. In a second or two the piece of ice of the size desired will quietly crack off. This method has its silence to recommend it.—C. B WHITEHOUSE.

A Built-In Writing Desk Made from a Bread Board

WHEREVER a compact writing desk is needed this type can be used to advantage, especially in the summer cottage. The desk itself is nothing more than a flat board. A bread board 16 by 22 in. would be about as satisfactory as anything. First decide on the location. If, as in a summer camp, there is no plaster and the studs are exposed, the position of the desk may be between two of the studs. If there is plaster, it will have to be broken through between two studs. About 30 in. above the floor and between the studs nail another piece the same size as the studs like a header. From this cross-piece hinge the bread board as shown in the illustration and fasten it to a chain on one side to hold it in a horizontal position when it is down. On the inside of the desk top fasten a blotter, and adorn the outside with a picture. The studs are usually spaced about 18 in. on



The built-in writing desk as it appears when it is open and closed

centers so that a clear space of about 16 in. will be in the wall between them. The back of this may be used as a space for a rack for papers and hooks for pens and pencils and place for ink, etc. The illustration furnishes a suggestion as to what can be done and how the desk looks when it is closed and out of the way.—HAROLD V. WALSH.

A Completely Equipped Portable Cabinet for the Photographer

THE case shown is 24 in. high, 30 in. long and 6 in. thick. It may, of course, be made any size, but this one can be placed behind a door or in a closet out of the way, and is large enough so that the printing box compartment will accommodate a 5 by 7-in. size or smaller. The capacity of the case is surprising. On the upper left door are the scales, which can be tilted to bring them level, a dropping glass, stirring rod, palette and tweezers. On the upper half are eight 4 by 5-in. holders and an exposure meter. On the upper center shelf is room for all sorts of sensitized paper up to 12 by 14 in. in size for enlarging, and the latest negatives. On the right side the shelves occupy only half the width, the remainder being placed on the door.

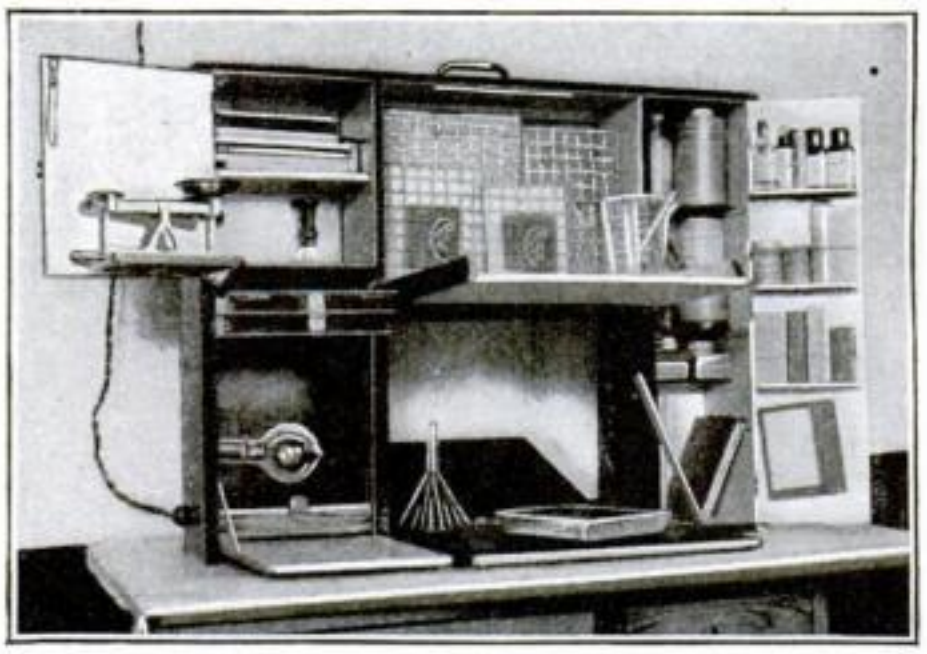
The cabinet when closed can be carried easily

In the case will be found 1 lb. of sodium carbonate, ½ lb. of sodium sulphite, 1 oz. potassium metal-bisulphite, 1 bottle retouching varnish, two 3 oz. bottles of toner, 1 box of potassium citrate, 1 box potassium bromide, 1 box of copper sulphate, 1 box powdered alum, 1 box citric acid, 1 box chrome alum, and 1 glass funnel. In the bottom section is a book of formulas. On the door is 1 bottle each of 10 per cent bromide of potassium, pyro, aerol, and amidol, 1 box hydroquinone, 1 box of potassium ferricyanide, a pack of filter paper, 1 box of opaque, 1 box of sepia toner, 1 box of green toner, 1 box of intensifier and a rack for masks at the bottom.

When the two doors shown in the lower central portion are closed, the trays, trimming board and blotting pad may be stored therein. When these doors are lowered they at once become available for holding the various trays in development. The door in the foreground is covered with rubber. The lower central portion is also provided with a folding rack for glass plates and with clips for holding films while drying, which keeps them out of the dust.

At the lower left is the printing box, the inside of which is painted red and provided with a curtain of ruby fabric, shown partly raised from the bottom. This runs in grooves and is held up at the top by a spring, thus closing out all white light, making a fine dark lantern.

What appear to be two narrow drawers above the lamp is the printing frame, the lower half slides out only half way and the top part the rest of the way, so that a negative may be inserted and removed easily. The red light reflected from the white enamel door below, throwing the rays up through the negative, makes placing the paper an easy matter. The corner shown partly raised is fastened to the frame so that when the frame is pushed back in the case it is forced down in close contact with the paper and negative by two flat springs placed beneath the compartment housing the scales. This door is also provided with a spring to open it, as shown, as it is withdrawn from the case. This, of course, stops the printing.



The cabinet opened showing the compartments for the chemicals, plates and papers

The lamp shown is for enlarging; the one for printing is back of the curtain

where the wire enters. The curtain, when released, rolls down out of the way, being actuated by a spring such as used on window shades. Inside the central portion is a switch for shifting the current from one light to the other. The brass corners and handle were purchased. The case was painted inside and out as a finish.—I. E. PETTIBONE.

A Homemade Sawdust-Burning Heating or Cook Stove

HERE is a little new-style stove which will save your coal. It burns sawdust. You can make the stove yourself if you are handy with tools. It is simply a cylindrical box made of sheet iron, about 7¾ in. in diameter and eight inches deep. It has no lid. The box should be filled with sawdust to within an inch of the top, leaving the rim, which is pierced with eight holes ¾ in. in diameter, uncovered. Three small pieces of sheet iron, bent at right angles and riveted inside below the top, serve as brackets to support the cooking utensil at the right height above the flame.

Before filling the box with the sawdust, a piece of wood 10½ in. long, tapering from 1¾ in. in diameter at one end to 1¼ in. at the other, is placed, small end downward, in a vertical position at the bottom of the box. Another piece of wood 1¼ in. in diameter and 6 in. in length is inserted through a hole in the side, at the level of the bottom. One end of this piece is slightly hollowed to fit the lower end of the vertical piece. These two pieces of wood act as a kind of core around which the sawdust is packed and rammed down hard with a wood rammer. After the sawdust is packed in, the pieces of wood should be removed, leaving two holes, one vertical and the other horizontal. Through the vertical hole a few drops of kerosene are poured, and through the horizontal opening a lighted taper is inserted. As soon as the sawdust catches the blaze, the cooking utensil may be placed over the top. The fire will burn from three to six hours without replenishing and without flaring up. It gives off a good heat, sufficient for any kind of cooking or for laundry work.—JAMES A. CARTER.

The Animated Match Box on the Back of the Hand

DO this trick before a mirror and you will actually surprise yourself. Although exceedingly simple it is very perplexing to the onlooker. Take an ordinary match box and lay it flat on the back of your hand. At your command it will "sit up" or "lie down." Moreover, it will accomplish the task slowly or rapidly at your own will. No threads, wires, wax or weights are used. Nothing but your hand and the match box. Try it as you read this.

The skin on the hand is gripped in the box

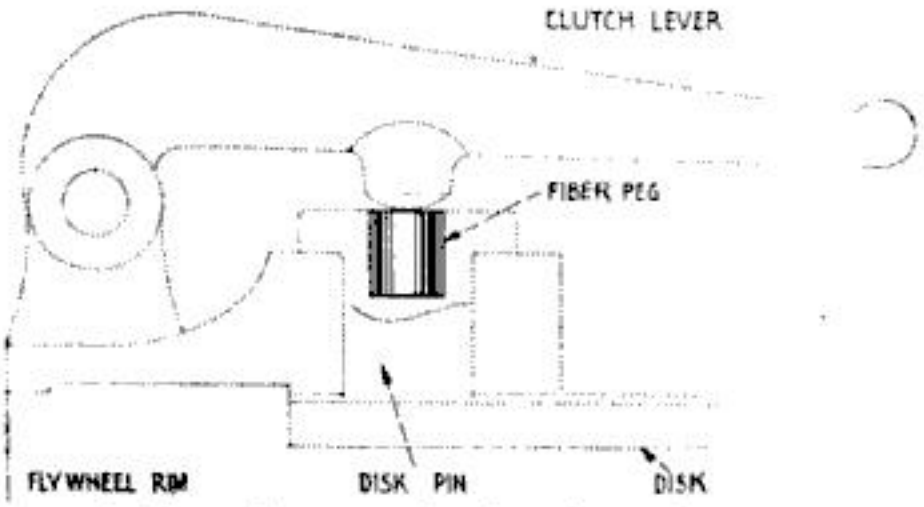
When placing the box on the back of your hand have the drawer open just the slightest bit. Push it together with the fingers of the hand that is placing the box. This will cause a bit of the loose skin to catch in. The box will lie perfectly flat until you push your closed up fingers into your palm. The slightest strain will tighten the skin and the little box full of matches will gradually rise up in the most amusing manner. To have it "lie down" merely relax the pressure. As you do this not a muscle or vein will move. Only the slight "pinch feeling" of the skin will keep you from fooling yourself.

Tire Damage Caused by Driving in Street Car Tracks

ROUGH streets tempt one to drive in car tracks. It is more comfortable for the passengers and may seem more of an economy to protect the car on special occasions from bumps and unusual vibration by running in car tracks, rather than over rough, cobblestone pavements. The tires will not be injured by doing this occasionally; however, to continue the bad practice shortens the mileage of the tire. Quite often the pavement along the inside edges of the rails is very rough and may result in cuts to the rubber and bruises to the fabric. Driving over street car track switches, the pointed frogs may cut the tires beyond repair.

Inserting Hard Fiber Plugs into Automobile Clutches

THE studs that disengage the dry plate clutch of a certain make of automobile are made of a softer material than the disengaging levers. This causes the plugs to



A fiber plug to take the place of a worn-out steel stud in an automobile clutch

wear rapidly, necessitating the replacing of them frequently.

To avoid the expense of purchasing new studs, we inserted hard fiber plugs to put the stud into proper condition again. These plugs were inserted into tapped holes, and when removing an old one it was merely necessary to drill out the larger portion and then force the balance out by running a tap through the threads.—ADOLPH KLEIN.

A Loose-Leaf File in Which to Keep Photographic Films

THE filing case is made of a loose-leaf note-book, of a kind having the leaves held at one of the narrow edges, and in which they are as large as the films that are to be preserved. Holes that correspond in size and location with those in the leaves of the note-book should be punched into the margins of the films. The printing quality of the negatives suffers no injury from this operation, as the margins are blank.

Into the binder are inserted alternately a loose leaf and a film. On the face of each loose leaf may be written a complete record of the following film. By this arrangement each film is separated from the others, and is well protected. By inserting at the beginning of the book an extra leaf on which an index is kept, and by numbering the leaves, any film may be instantly located.

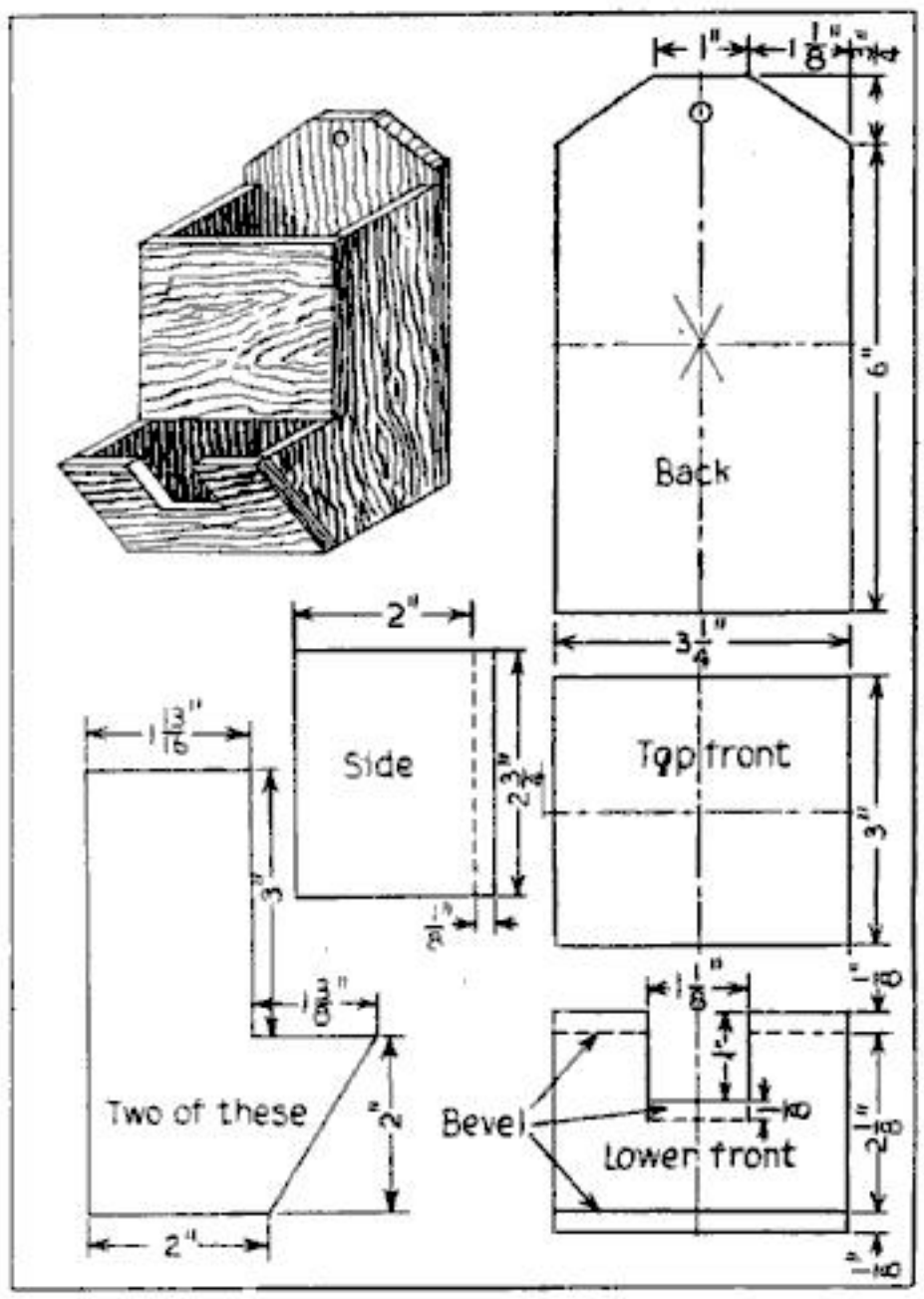
Where a large number of films are to be preserved, it will be most practical to file them in separate binders, sorting them according to their descriptions, such as portraits, landscapes, etc.

When any film is removed for printing, its accompanying record leaf should also be removed, to prevent the two from becoming separated.—F. M. WAGNER.

An Automatic Match Safe for Holding Box Matches

A VERY useful match safe can be made from any ordinary ¼-in. wood. It is convenient because after the cover is taken from a match box it can be slid right into the safe, and also, because it can be hung on the wall as well as set on a table or shelf.

The dimensions on the accompanying illustrations are for ¼-in. stock and they should be slightly changed if the wood is of any other thickness. The accompanying illustrations show the construction of the safe as well as the dimensions.



Plans for making a match safe to hold a box of matches and to deliver them a few at a time at the bottom of the box

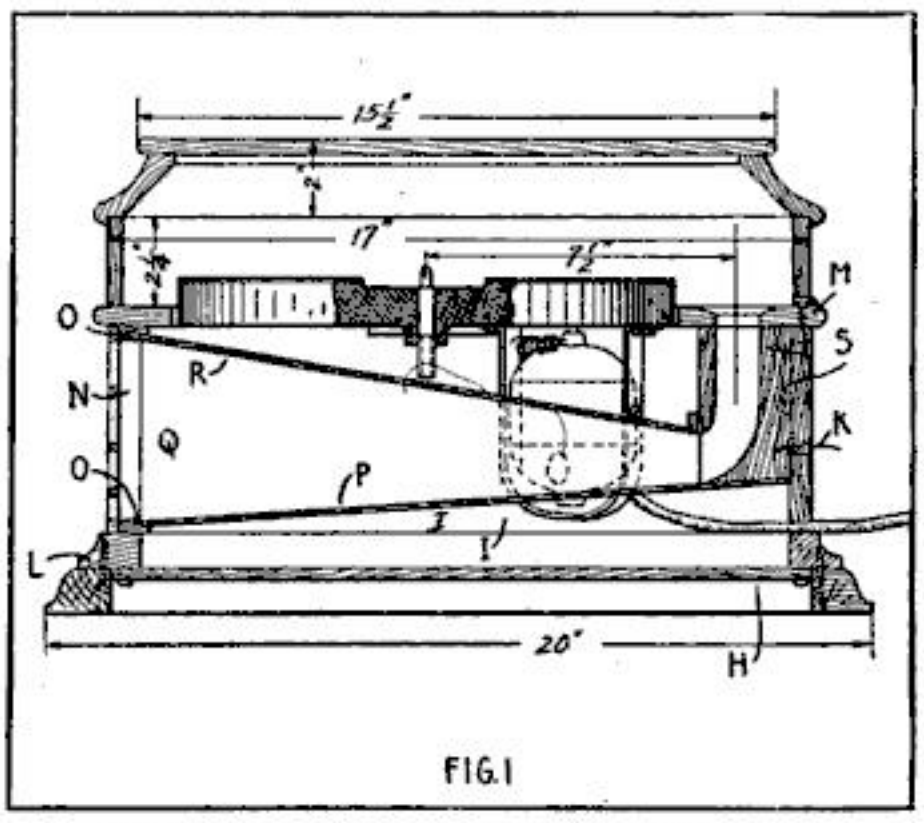
If a match scratcher is wanted on the safe, a piece of sandpaper may be glued to the top front piece.—G. EARLE MCCOTTER.

Making a Talking Machine

A simple construction within the scope of the amateur

By Charles Horton

THE talking machine herein described is of the well-known so-called "hornless" type in which the horn is of rectangular cross-section instead of circular, and is concealed within the base of the instrument.



Details of the turntable and the location of the electric motor for driving it

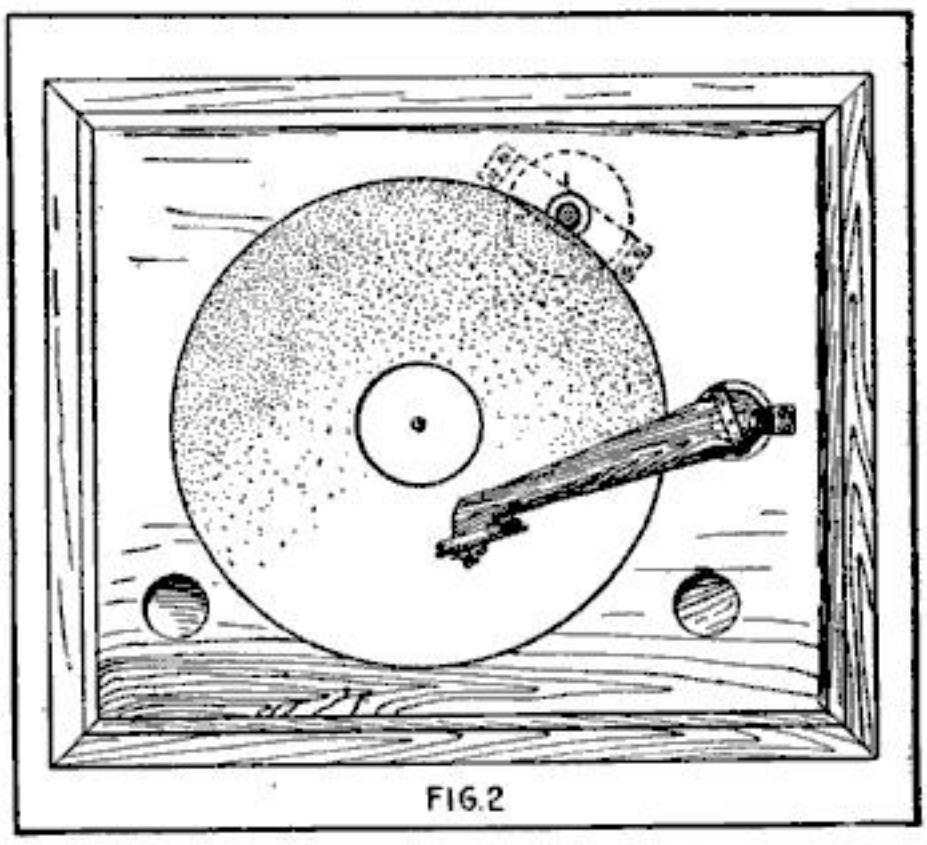
Contrary to general opinion among experimenters the talking machine is a very simple instrument and not difficult to make, provided the underlying principles are understood and correctly applied.

The chief difficulty, of course, is in making the spring motor.

Sound is understood as that disturbance in the air body which is capable of causing vibration of the ear drum with consequent typical sensation. There are various kinds of sounds, which may be roughly divided into two classes—noises and musical sounds. Noises are unsymmetrical groups of sound waves. Musical sounds, on the other hand, are symmetrical groups of sound waves. A musical note is a group of sound waves occurring in perfect rhythmical order. The rapidity of vibration of any sound wave is called the "pitch," and the quality due to the overtones is called the "timber."

The talking machine is a machine for reproducing sounds from permanent mechanical records of original sounds. The record is made by allowing the original sounds to impinge on a flexible diaphragm the resultant movements of this diaphragm being arranged to cause a needle point to trace in a soft substance in motion a wavy line characteristic of the impinging sounds. The reproduction is accomplished by practically the reverse of this process and the tones are amplified by allowing them to pass through a resonant chamber.

From the above it will be readily understood why the phonograph is imperfect in its reproduction; for while it is easy enough to record and reproduce the fundamental notes, some of the complex overtones are of very high pitch and also of very small magnitude and are consequently lost, either not being recorded at all, or not being reproduced, or being lost in the reproducer and resonant chamber. Furthermore, since the pitch of a musical note determines the note, even the slightest variation of the speed of the record changes the pitch of the music. Also the resonant chamber sometimes adds typical overtones to the music. Thus the two principal problems to be solved in making a talking machine are, first, to secure a good reproducer and, second, to secure perfectly uniform speed of the turntable.



The top plan shows the turntable with location of the arm and two needle tills

This instrument is arranged to use motor drive, as motors are cheap and easily applied and if alternating current is available a constant speed is easily secured. The tone arm and reproducer are to be made of wood,

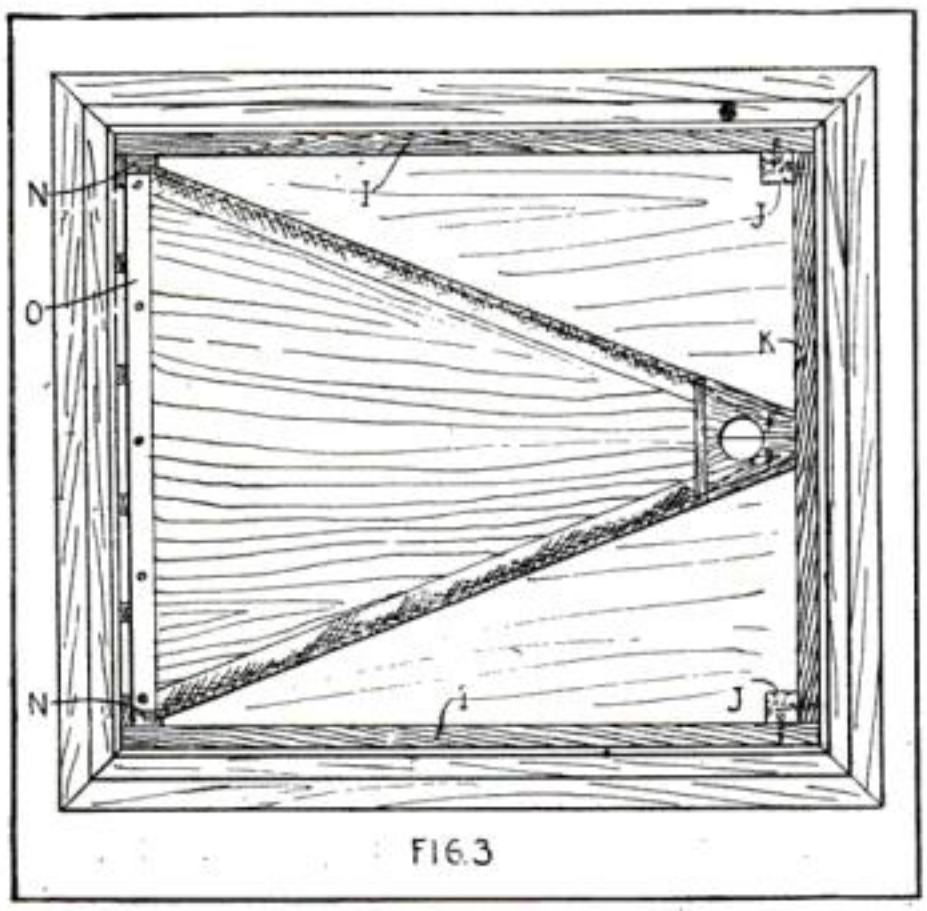


FIG 3

Here is shown the horn or sound box beneath the turntable cover and the cabinet fastenings

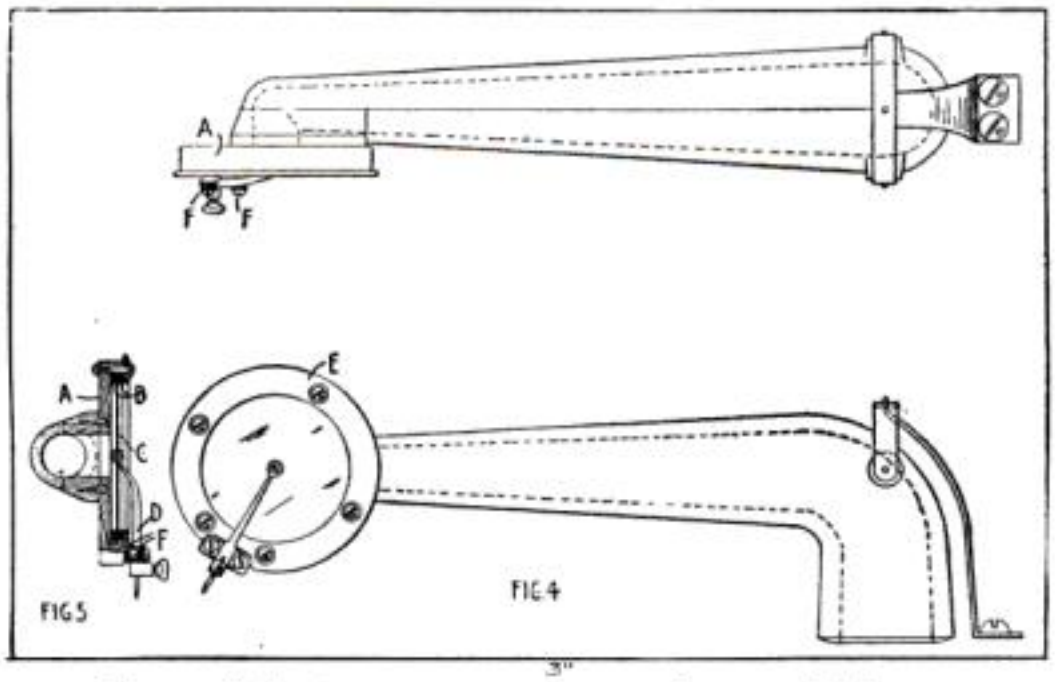
which is more easily worked than metal and is generally more desirable. The most recent phonographs placed on the market have a wood tone arm.

Any type of motor, preferably shunt wound, may be used and should develop only a few hundredths of a horsepower. The motor usually used on an 8-in. fan is ideal and of the right size. The speed should preferably be not over 3,000 R. P. M.; but this is not essential as the speed can be controlled by resistance. A motor should be selected which has a uniform rate of speed. The method of mounting a motor of the "globe" type is shown in Fig. 1, in which the motor swings on pivots in a strap-brass frame secured to the top panel, and is held so that its friction wheel bears against the turntable by a suitably arranged spring. For any other type of motor a suitable mounting must be developed but should always be sufficiently resilient to produce enough pressure for driving. In order to insure uniform speed of the turntable the disk is made very heavy, so as to act as a flywheel. The driving pulley should be so proportioned as to give a speed normally of 80 revolutions per minute. The motor pulley should be covered with a piece of soft rubber tube to cause proper friction. The turntable should be made of cast iron and carefully turned in a lathe. The center pin is forced into the disk and rotates freely in the bushing beneath, which is mounted in the crossbar shown secured to the underside of the top. The turntable is 12 in. in diameter and 1 in. thick.

The top view of the machine with the cover removed is shown in Fig. 2. Here the wooden tone arm is shown and the position of the motor. The two holes in the top are for new and used needles. The turntable is covered with a layer of felt stuck on with shellac.

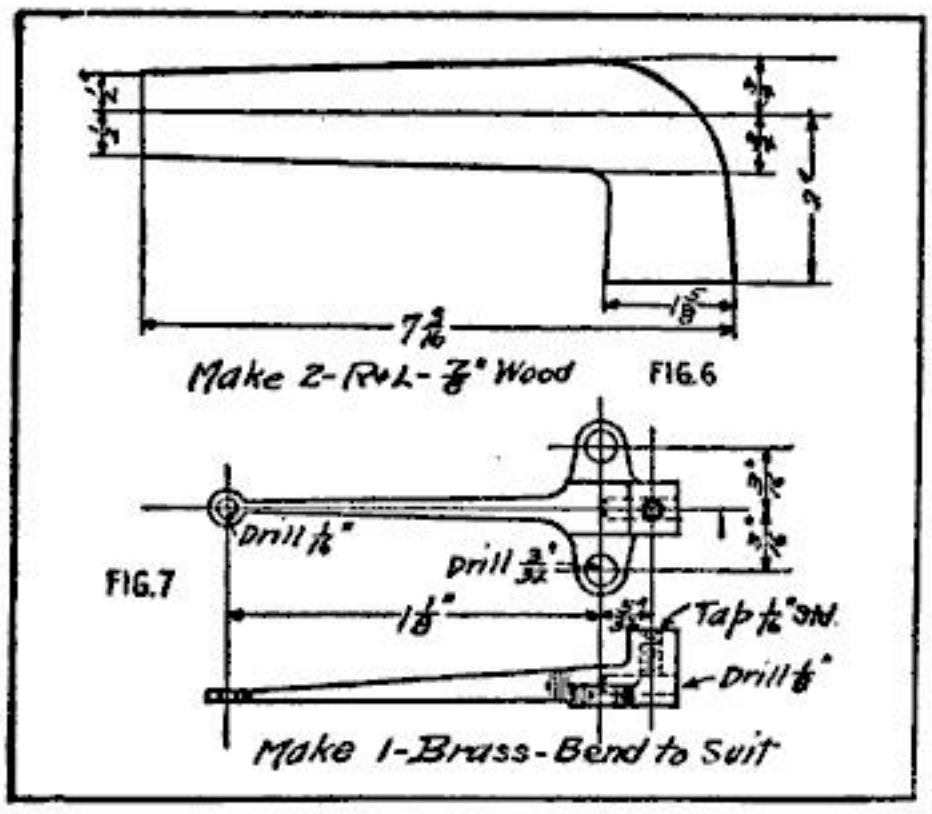
The top view, Fig. 3, of the cabinet with the top removed shows the horn and the method of fastening the cabinet by screws through corner pieces, thus preventing them from showing on the outside.

Three views of the wood tone arm and reproducer are shown in Fig. 4 and Fig. 5. The arm is made of two pieces sawed out roughly as in Fig. 6, then gouged out and sandpapered to make the tone passage. Afterward the two pieces are glued together while firmly clamped in a vise and finally carved down on the outside and polished to the shape shown in Fig. 4. The reproducer sound chamber, Fig. 5, is simple. It consists of a wood back, *A*, a pair of rubber rings *B*, the mica or celluloid diaphragm, *C*, the stylus *D*, and the clamping ring, *E*, which should be of brass 1/16 in. thick. Four 1/16



Plans of the tone arm and reproducer which are easily constructed from wood and metal rings

bolts arranged as shown secure the parts together. The stylus is best made from a single piece of brass with the aid of a fine-toothed pack saw and a few files. A detail



Dimensions of the wood for making one-half of the tone arm and stylus details

view of the stylus is given in Fig. 7. The stylus is mounted freely between small rubber washers *F*. The thumbscrew is made from a small round head-iron machine screw with a crosspiece soldered in the kerf.

Detailed drawings of the cabinet parts are shown in Fig. 8. The bottom molding is shown at *G*. This can be made from any suitable standard molding or gouged out with hand tools. Four corner pieces are glued and screwed in as shown. The closing panel for the bottom of the cabinet is shown at *H*. The side pieces are shown at *I* and the corner securing cleats at *J*. The back piece is at *K*.

Other cabinet details are shown in Fig. 9. Eight screws secure the base *G*, Fig. 8, to the molding part *L*, Fig. 6. The top panel is shown at *M* and the horn mounting strips at *N* and *O*. The bottom, sides and top of the horn are shown in *P*, *V* and *R* respectively. If desired the horn can be made of ⅛-in. hard cardboard.

One-half of the tone-conducting chamber which connects the tone arm with the horn is shown in Fig. 10. It is made of soft white

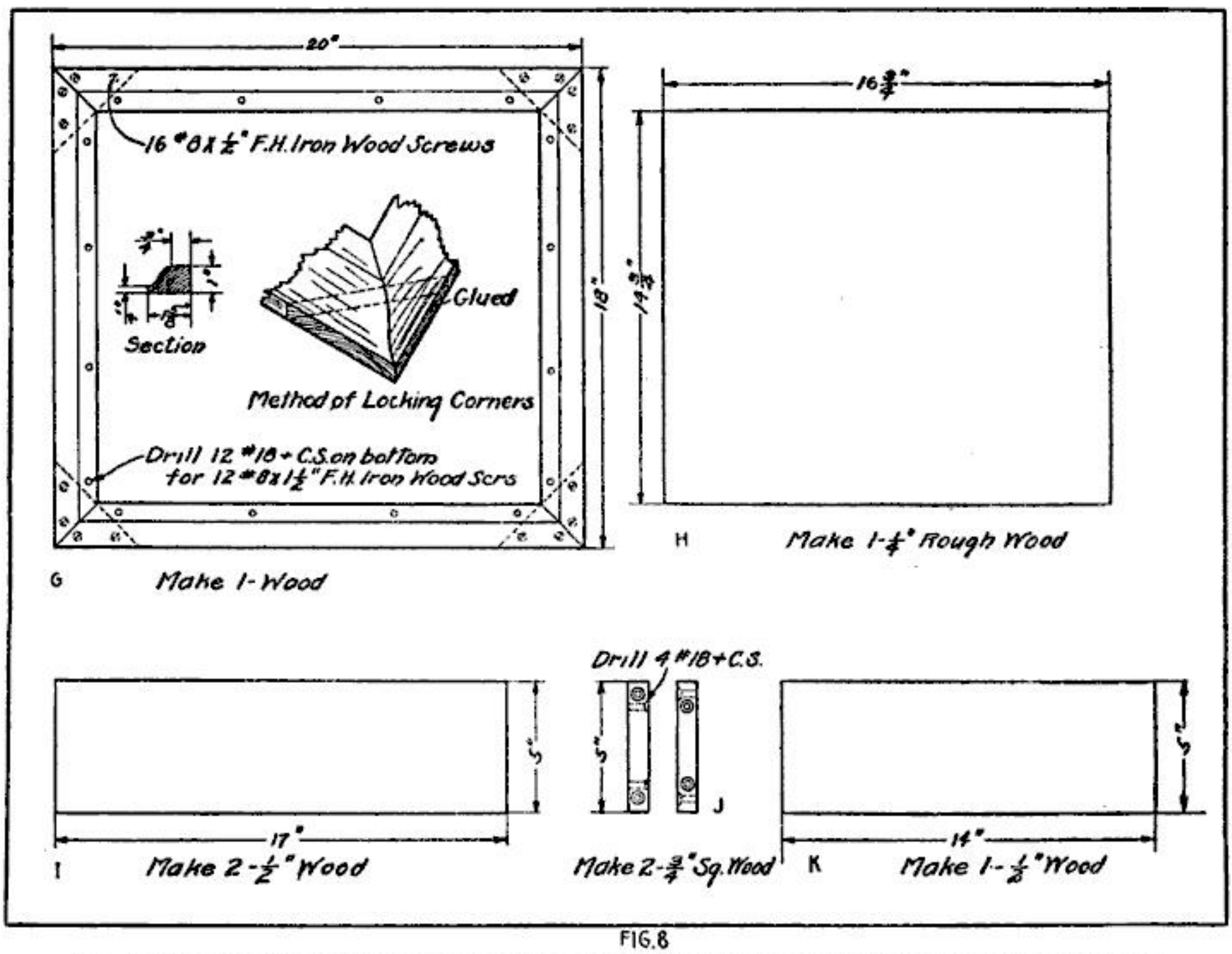


FIG.8

Top molding details together with the three sides and bottom board which may be made of any wood desired, cut from rough stock and shaped by hand, or purchased from a dealer

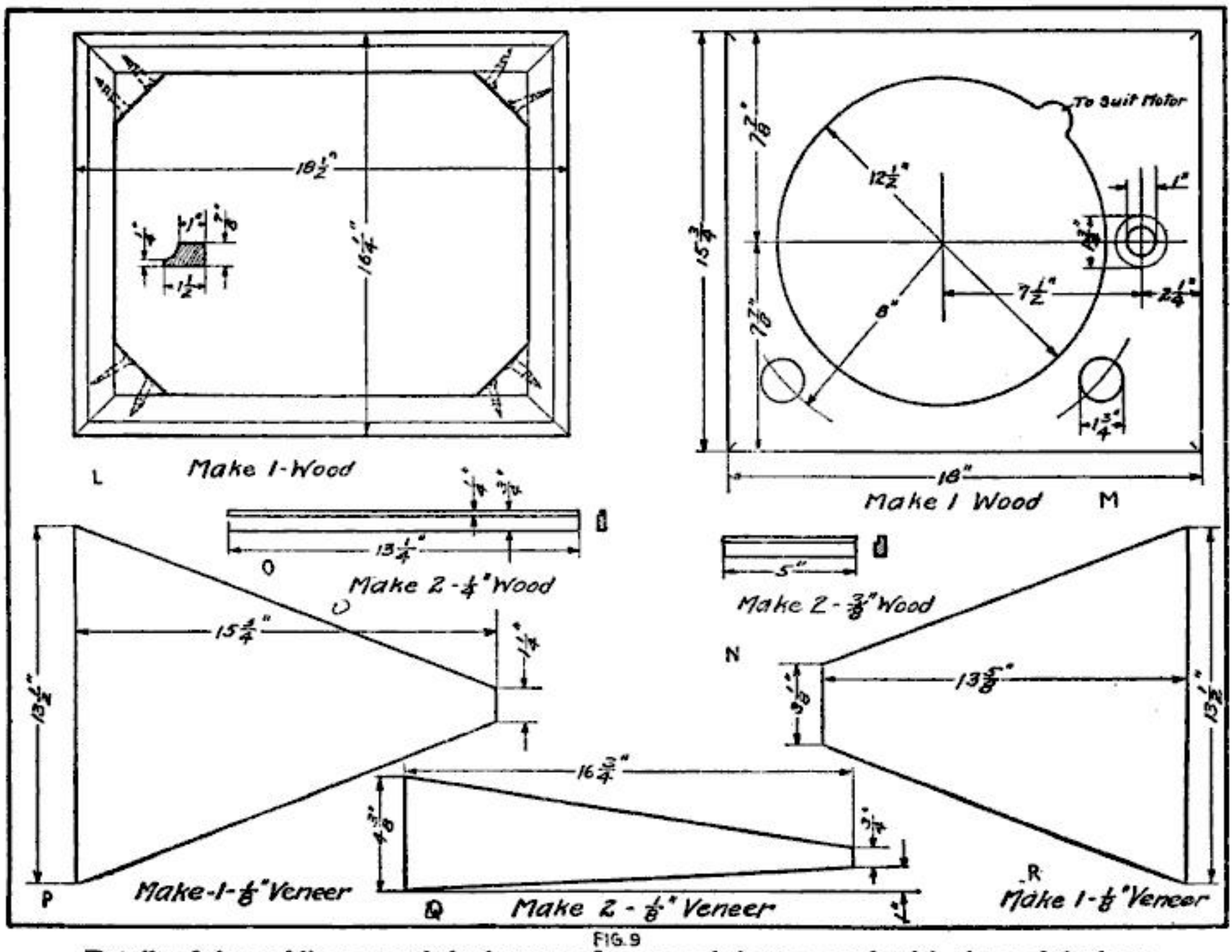


FIG. 9

Details of the molding around the bottom of cover and the top panel, with those of the horn or sounding box sides. All inclosed woods may be of soft pine or other similar soft wood

pine. The other half is made similar but reversed, and the two parts are glued tight together. The sections of the horn are closely secured along the four corners by glued on strips of muslin and the small end of the horn is slipped over the finished piece and glued and nailed with small brads.

Any looseness will cause vibration. Mahogany is preferable, but any wood desired can be used.

The cover is hinged to the cabinet at the back. Other parts will be made clear by reference to the drawings. This machine if carefully made will prove very satisfactory and attractive.

If desired, the front opening of the horn may be closed with a wood grill work cut out with a scroll saw. This gives a very pretty effect; or a fine piece of green silk may be used as in some commercial machines.

After completing the cabinet work and after all the mechanical parts are inclosed, sandpaper all surfaces smoothly, removing all surplus glue; then select a stain suitable for the finish. Apply the stain according to the directions on the can and put on a wax coating as directed on the package. Rub thoroughly then apply another coat and finish with a rubbing.

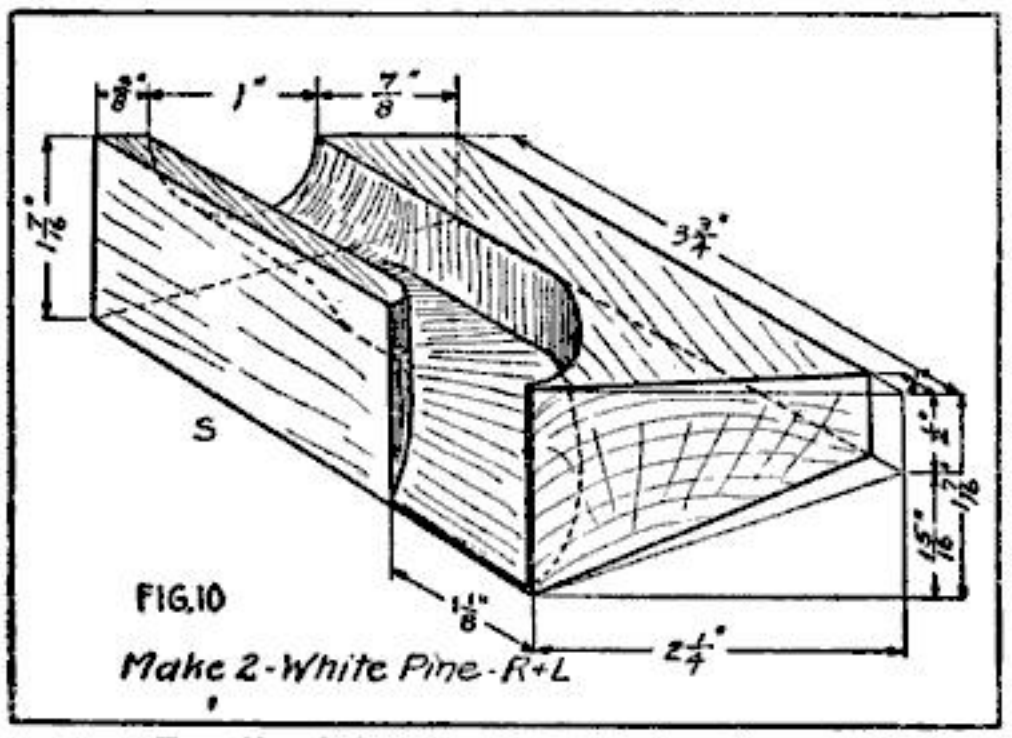


FIG. 10

Details of the tone conducting chamber located at the base of the tone arm

A Simple Method of Securely Fastening Umbrella Handles

IT frequently happens that an umbrella having an expensive handle will get broken. The owner may naturally desire to have the handle put on another umbrella. By following these instructions any person can make the change of handles.

Clean out the hole in the handle, then wrap a few layers of cloth on it and clamp it in a vise, using just sufficient force to the jaws to hold it upright. Then put powdered sulphur in the hole—heat the end of the umbrella rod red-hot and push it down in the sulphur. The heat will fuse the sulphur and cause it to grip the rod tightly. This method can also be used to fasten rods into stone, iron or wood.—W. S. STANDIFORD.

Inserting Manifold Papers Evenly in a Typewriter

THE insertion of manifold papers is a job which taxes the patience of many who have occasion to use the typewriter. It is difficult to keep the papers "squared." The difficulty may be overcome by folding a narrow strip of paper, placing it over the top of the sheets, and then inserting them in the machine. This keeps the sheets in the desired position.

Laying Out and Finishing a Plain Blanking Die

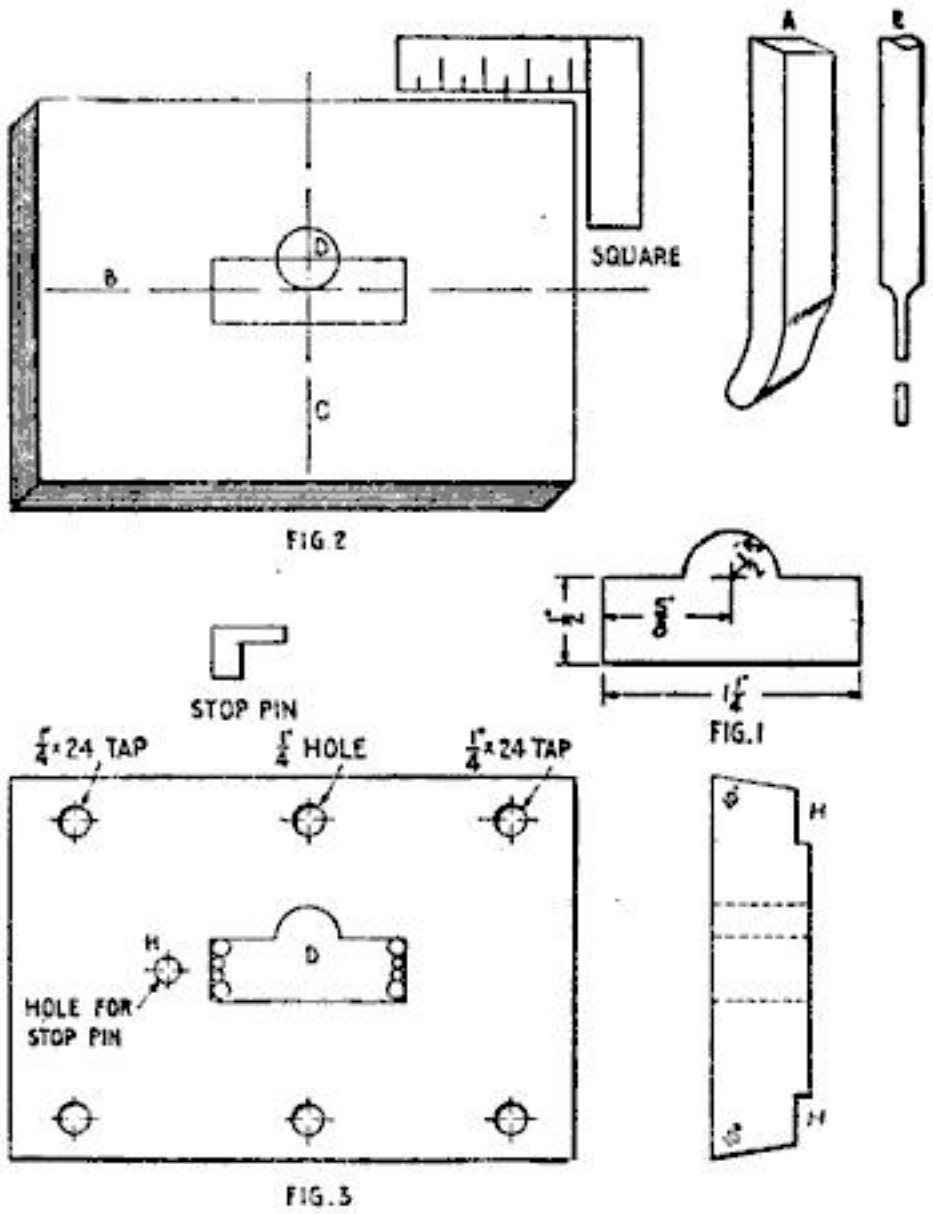
THERE are numbers of good machinists who, with a little instruction, could qualify as tool and die makers, for whom there is great demand. The following article deals with a very simple die, but it gives some idea of the fundamental rules so that a lathe man who masters the instructions given will not be entirely inexperienced when called on to do this work.

We will assume that a die is required to blank some pieces of No. 20-gage hard sheet brass, and the dimensions called for are as given in Fig. 1. The tools necessary for this layout are the square, dividers and scriber. The steel for the die is placed in the shaper, and unless the sides are unusually rough, a cut is taken on the piece to be used for the bottom. After this is done the piece is reversed and the top is planed off and smoothed with a tool, as shown at *A*. Again clamp the piece in the planer and trim off the four sides, taking care to make them as square as possible. This will be a great aid in laying out the more complicated die work. It is very necessary to have a bottle of blue stone solution at hand, which when applied to the surface of the steel will produce a copper-colored coating for taking the lines that are drawn thereon for the work.

After the blue stone has been applied, scribe the center lines *B-C* Fig. 2; then the lines ¼-in. on each side of the line *B;* draw the intersecting lines at the end, always measuring from the center. The radius of projection is ½ in. and is measured with the dividers, taking for a center the point on the line *C* at *D*. The die is now laid out.

For drilling the core, a line is drawn on the inside as in Fig. 3, on which there are spaced the punch marks so that a drill will not quite touch the outline when drilling the holes. This spacing should be as close as possible so that the core can be easily removed.

Before the holes are drilled, the die is strapped to the face plate of a lathe, and

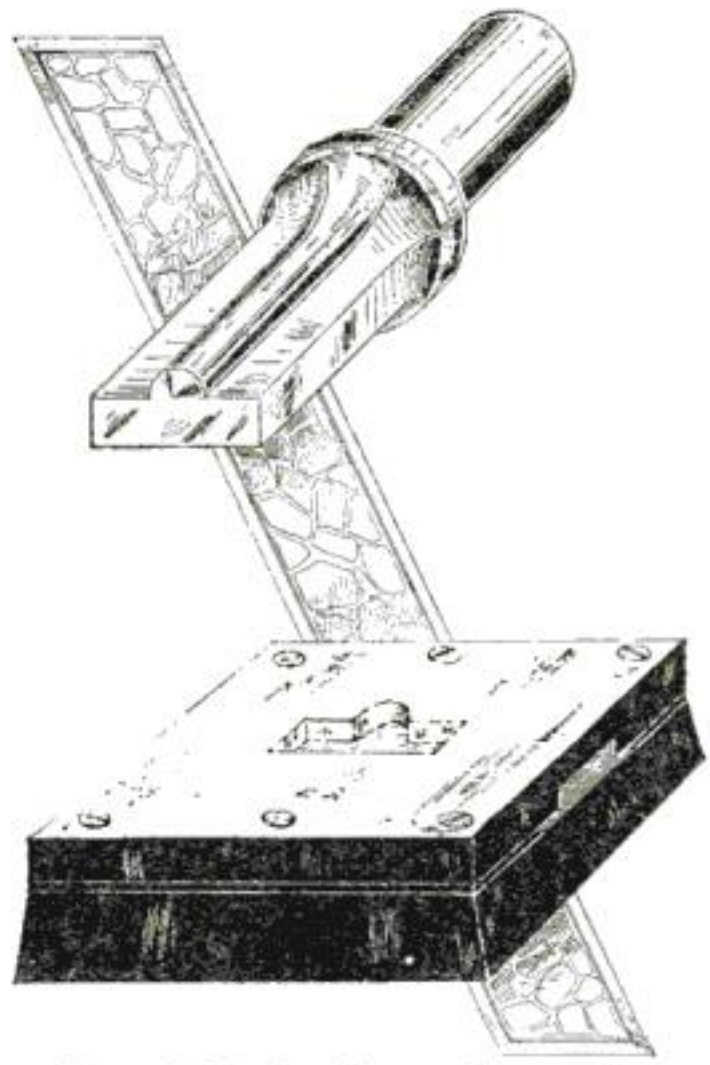


Shape and size of the piece to be punched, details of making the die and tools used

after centering it on *D* it is drilled and reamed to size. The clearance for the passing of the blank at this point can be made by adjusting the compound rest on the lathe carriage, instead of filing the die after-

wards. When this is done the die is removed and the core drilled out. A flat chisel as shown at *E* is necessary to break the web left from the drilling of the core. Do not drill the holes too close to the die line, for a cut over the outline will make it necessary to use a putting-on tool. It is easier to remove the stock by filing than to hammer the steel to fill the space.

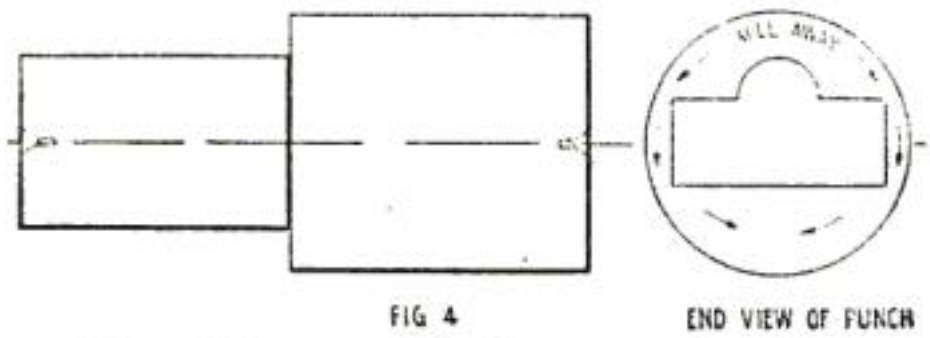
The die being small it is not necessary to use a milling machine for finishing. The finishing is done by chiseling off most of the web and then filing to the lines. When this point is reached and the proper clearance is made, the die is again placed in the shaper and a cut taken on both sides of the die as at *F*. This is to make the clamp hold and to prevent the die from lifting out of the bolster. In case of mishaps necessitating regrinding, the die should be cut away as at *G*, which saves time. A depth of ⅛ in. is sufficient. Four holes are now drilled and tapped as shown for ¼-in. screws having 24 threads to the inch. Two holes are also drilled for dowel pins.



The finished die and punch ready for the power press

Do not forget that there must be a stop for the material after it is blanked. For this purpose a hole is drilled at *H* and a pin driven in and bent over.

Die makers are not always permitted to do their own hardening, but should this be a part of your work proceed as follows: Fill up the drilled holes with fire clay to prevent any possible stresses or cracking. After ascertaining what kind of steel you have, and the treatment required, heat it to the proper temperature, or color, and quench it quickly in water or oil. After hardening the surface of the die, clean it and replace it in the furnace to bring it to a dark straw color, or 460 deg. F. The die is now ready for use in making the punch, which is shaped from a round piece of steel 1½ in. in diameter. A piece of the steel is cut to the right length; the ends are centered, put in a lathe and turned down, as shown in Fig. 4, to the size necessary to fit the punch holder for the press work. When this is done, brighten the large end and apply the blue stone solution; clamp the end in a vise and lay the die upon it. Transfer the outline of the die with the scriber.



Plan of the punch and manner of cutting the metal away to make the proper shape

Next, take the piece to the milling machine and clamp it in the chuck of the index head or between centers. Mill all around and up close to the line scribed, as shown in the end view. Then remove it from the chuck and file it so that the punch will just about enter the die; now adjust it in the press as if for use with the already made and hardened die, and "shear it." Care must be taken to see that the die will remove some metal from all sides. When located properly, force the punch into the die. If too much material has been left on the punch, do not attempt to force it through, but remove again and file to mark obtained by this operation. To insure a good, smooth finish as little material as possible should be left to shear.

The punch is hardened in the same manner as the die and the cutting edge is ground sharp. To complete the job we must now make the stripper plate. A piece of machine steel of about ½ in. thickness, as shown in Fig. 5, is clamped on the die and holes are drilled to coincide with the hole of the die. After the plate is secured to the die the outline of the blank is scribed on the stripper plate in the same manner as on the punch. The core on this plate is drilled out in the same way as for the die. It is filed close to the lines; and punch and die are set on the press again. When

the setting is correct the stripper is fastened to the die and the punch is forced through. It is not necessary to force the punch entirely through, as a part must be milled out

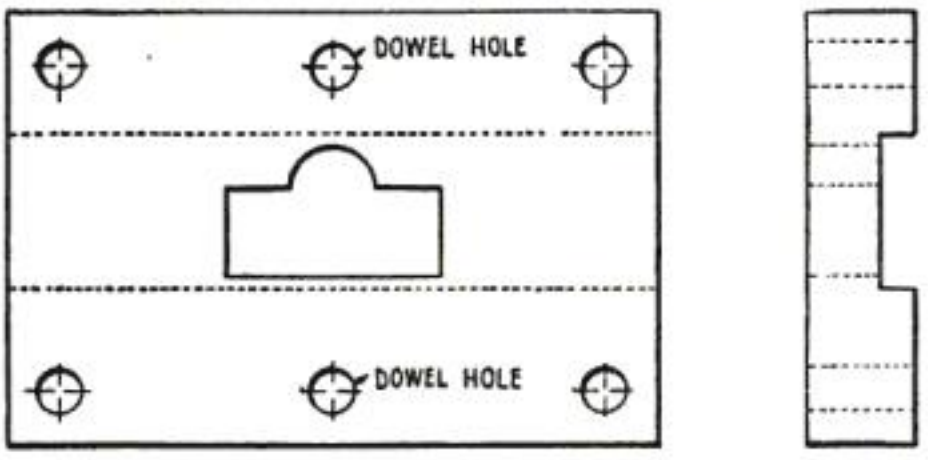


FIG 5

Stripper plate to prevent the stock from sticking to the punch when it is drawn

for the brass stock to pass through. For this die the material will be $\frac{7}{8}$ in. wide and the stripper milled to a depth of $\frac{1}{4}$ in.

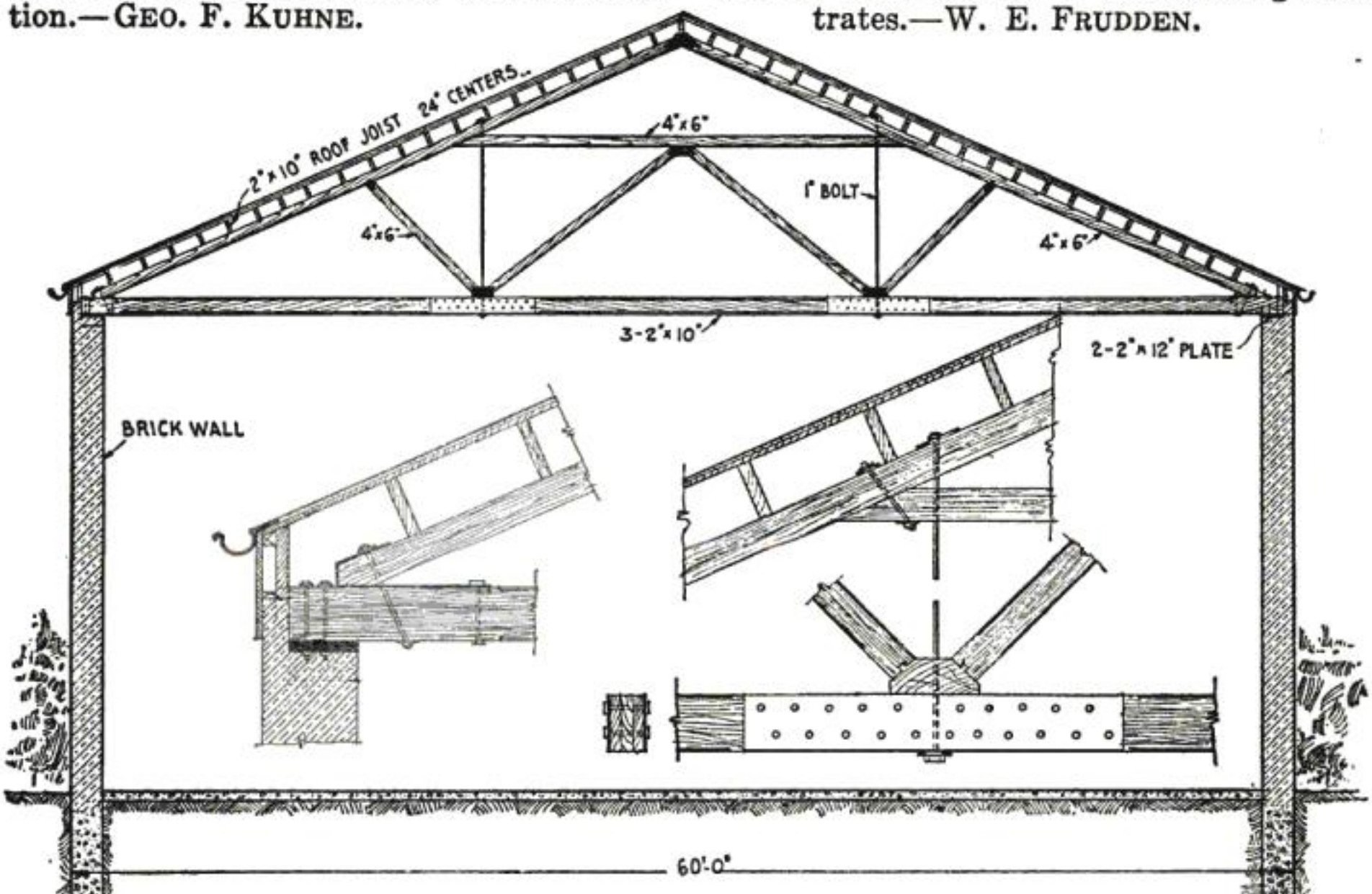
After removing all sharp edges from the stripper, the hole for the punch should be filed slightly to provide a sliding fit. When assembled on the power press a strip of brass is run through the opening, as the press is operated, and blanks are made at each stroke to the shape and size shown in the illustration.—GEO. F. KUHNE.

A Self-Supporting Roof for a Small Public Garage

IN rural districts many contractors are being confronted with the problem of building public garages without the troublesome posts to support the roof girders. The garage with posts here and there over the floor area is of little value. The plan here illustrated shows how an economical truss can be built of wood so that the roof can be supported without posts. This design is practical for garages as wide as 60 ft. and is built up entirely of wood timbers and 1-in. rods that can be purchased from any country lumber dealer's stock.

The lower member is built up of three 2 by 10-in. planks spiked together with joints staggered so that no two end butt-joints will be at the same place in the girder.

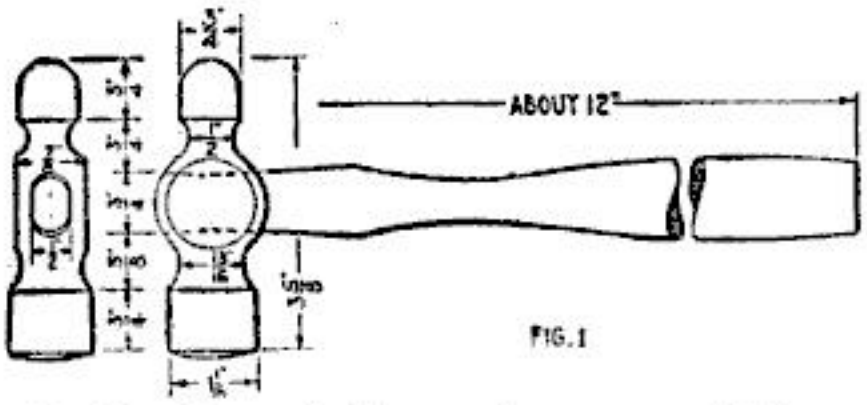
All the upper part of the main truss, is made of 4 by 6-in. stock, cut according to the pattern with 1-in. rods as ties, and double nuts at the bottom for tightening. The strap iron at the end of the truss is the main part. Any carpenter with ordinary skill can erect this design satisfactorily. Finish up with a neat cornice as the drawing illustrates.—W. E. FRUDDEN.



Supporting roof girders with a trussed frame having a lower member built up of three boards to make the length, all of which are spiked together with staggered joints. This provides a wide covering without supporting posts

Simple Designs for Hand-Made Mechanic's Tools

ONE of the first tools selected by the mechanic when collecting a personal outfit is the hammer, and the work which he intends to do decides one of the most important factors in hammer con-

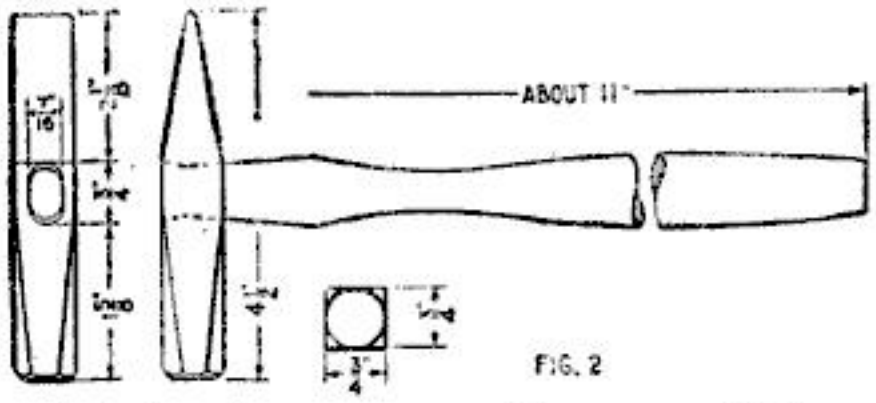


Design for a ball-peen hammer weighing seven ounces, forged or cut from bar stock

struction,—that of weight. While hammers can be purchased at a reasonable price, they, as well as other tools, can be hand-made. Such, when properly designed, are highly prized by the owner.

While working at the mechanic's trade I constructed in my spare time a number of tools, and to this day no other tools purchased seem to be so satisfactory or to fit the hand so well as those made by my hand. In making these tools only limited facilities were accessible such as any amateur may find available in almost any locality.

The hammer is the most used tool in the kit. It does the bulk of the work and the hardest part of it, and yet, without exception, it is given the least



A design for a cross-peen hammer weighing seven ounces, for doing ordinary riveting

amount of consideration in making, both as to quality of materials and appearance.

Of the several kinds used in metal work, two hammers will be considered, which are sufficient for ordinary work—a ball-peen and a cross-peen. A hammer, to set properly in the hand, should have the proper hang, which calls for correct proportions in the length from face to face as compared with the diameter, weight and location of the eye. The dimensions given in the detailed drawings are correct for weights of 12 and 7 oz. respectively, which are neither light nor heavy.

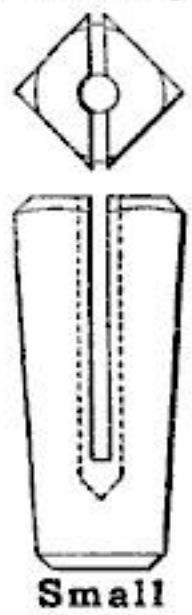
A good grade of about 80-point carbon tool steel should be used, forged to size, with just enough metal allowance to finish up. While doing this forging the eye is drifted in the metal. If forging is out of the question the head may be shaped from a solid bar in a lathe and the eye made by drilling out the metal and filing to shape.

The hardening or tempering is very important, for upon this depends the life of the tool. The usual method is to heat it all over to a cherry red, or about 1550 deg. F. pyrometer test in a clean fire, then quickly dip each end—the end only—in water for a distance of about ¾ in., until a fine straw color is obtained on each face or end. The steel is then polished, with a coarse grade of emery cloth first and afterward with a finer one about No. 0.

The handles are cut from second growth hickory, well thinned down in the neck so that a spring is formed.—A DANE.

An Auxiliary Chuck for a Carpenter's Brace

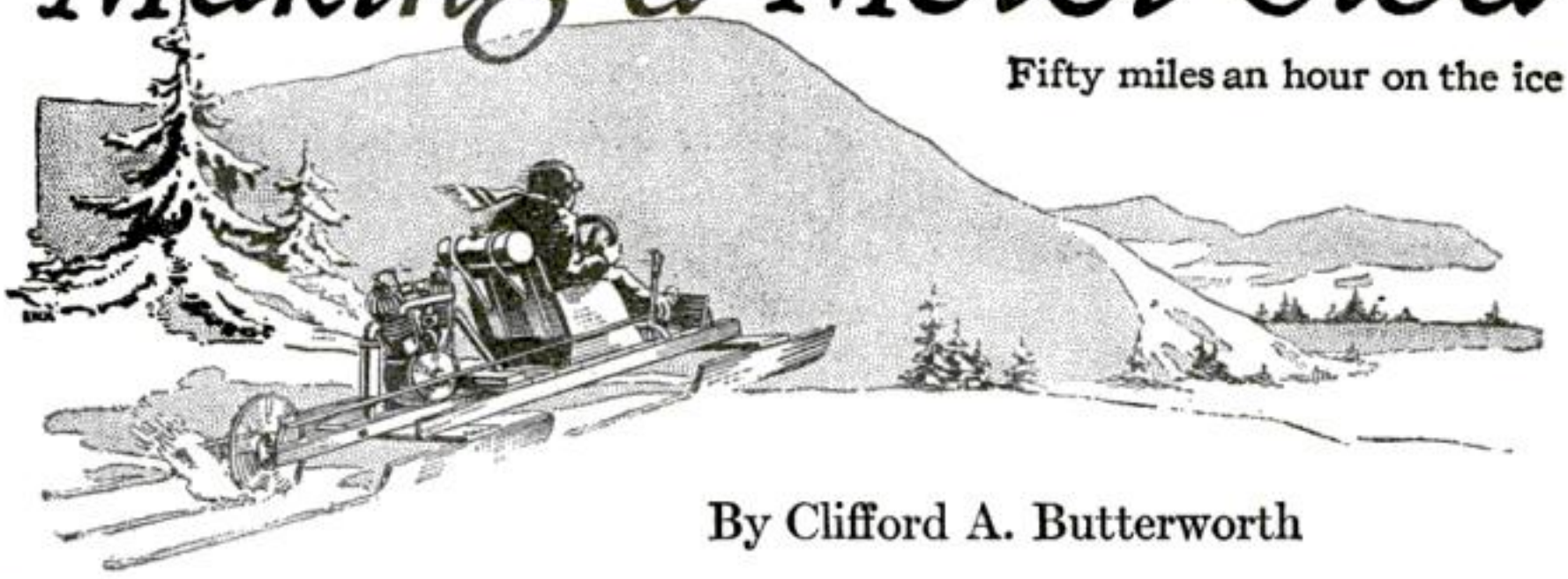
IT is a difficult job for a carpenter to hold a small round drill in an ordinary brace, as the chuck opening is so shaped that no grip can be had on this kind of drill. By using the device as shown in the illustration the drill can be held rigid. The pressure exerted by the chuck jaws closes the slot and jaws on the drill shank. This device can also be used for holding broken drills. The chuck may be made from a piece of machine steel in square form or filed from the round stock to fit in the brace. The hole through the center must be of a size to hold the drills most used, or else a complete set of chucks for the drill shanks should be made.—J. R. MINTER.



Small drill brace chuck

Making a Motor-Sled

Fifty miles an hour on the ice



By Clifford A. Butterworth

FOR those who like to make things, there is nothing better to construct than a motor-sled, and there is nothing from which more pleasure can be derived. The one shown in the illustration is capable of making from 40 to 50 miles an hour with a 9-horsepower engine. A 4 or 5-horsepower single cylinder engine will do, but of course it will not be possible to obtain as great a speed as with a twin cylinder engine. The few parts which require forgings can be made by the builder if he has a shop of his own. In case a blacksmith does the work the cost should not be very great. If the builder has a motorcycle he can save the cost of the engine, which is the largest expense. If the sled is well built it should last for years. The following is a list of materials required:

1 Motorcycle engine with ignition and oiling system
1 Motorcycle rear wheel with brake and chain
1 Gasoline tank
2 Pieces of pine 14 ft. long, 4 in. wide and 2 in. thick
2 Ash planks 12 ft. long, 8 in. wide and 1½ in. thick
3 Matched boards 12 ft. long, 6 in. wide
1 Board 2 ft. long and 8 in. wide
1 Piece of iron pipe 6 in. long and 1 in. in diameter
2 Flange couplings
2 Pieces of ½-in. pipe 4 in. long

Number and Size of Bolts Required

4	Bolts	8	by ½	in.	22	Bolts	7	by ½	in.
5	"	5	" ½	"	4	"	5	" ¼	"
2	"	4	" ½	"	9	"	3	" ½	"
4	"	1½	" ⅜	"	18	"	2½	" ⅜	"
7	"	1½	" ¼	"	6	"	1	" ⅜	"

2 Bolts 1 by ¼ in.

Number of Iron Pieces

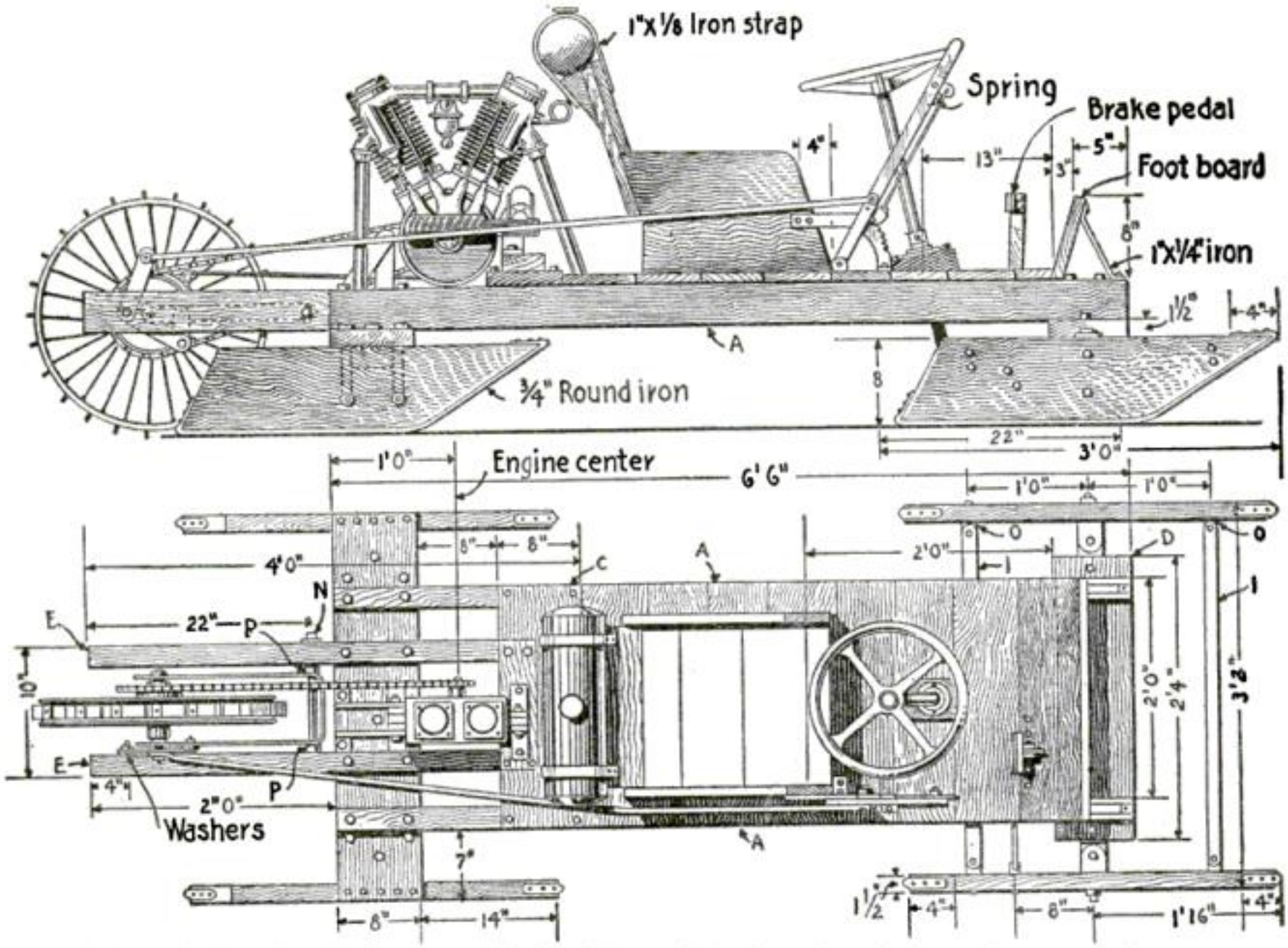
1 Piece 6 ft. long, 1½ in. wide and ½ in. thick
1 Piece 4 ft. long, 1 in. wide and ⅛ in. thick
1 Piece 7 ft. long, 1½ in. wide and ⅜ in. thick
1 Piece 11 ft. long, 1½ in. wide and ⅛ in. thick
1 Piece 24 ft. long, 1 in. wide and ¼ in. thick
1 Piece 3 ft. long and 1 in. in diameter
1 Piece 18 ft. long and ¾ in. in diameter
1 Piece 8 ft. long and ½ in. in diameter

Screws, Rivets and Wire

½ Gross of 1½ in. screws
10 Screws 3 in. long
3 Dozen rivets 1 by ¼ in.
8 Ft. of No. 6 wire

Begin the work by cutting the frame pieces *A* from one of the 14-ft. lengths of pine; then cut the pieces, *B*, *C* and *D*, from the ash plank, making them 3 ft. 2 in., 2 ft., and 2 ft. 4 in. long respectively. Bolt them to the frame pieces with the 7-in. bolts. Cut the two 4-ft. pieces, *E*, *E*, and bolt them in position; then cut another piece, *E*, 2 ft. 11 in. long and bolt it to the underside of *B* as shown in Fig. 1, with three 5-in. bolts. These last three pieces are cut from the other 14-ft. length of pine.

Cut the runners from the ash plank and make a V-shaped groove on the edge. This is used to receive the shoe iron for the bottom. Make the groove ¾ in. wide and ¾ in. deep. The shoes are made from the ¾-in. round iron, flattened at the end to ¼ in. and fastened to the runners with three screws in each end. Fasten the rear runners in place with five 3-in. screws through the piece *B* and four iron braces *G*. The steering knuckles are next assembled, as shown in Fig. 2, page 137. The pieces *H* are 6-in. blocks of 2 by 4-in. material fastened to *D* with 8-in. bolts. Bolt the runners on and put the steering rods *I* in place. Washers should be placed under



General plans for the frame and bob sleds, and the location of the engine, tank, levers, steering column, seat and propeller wheel. The dimensions may be changed to suit the needs of the individual builder, but these are right for general uses

all nuts which bear directly on the wood. Put on the foot board and fill in between it and the piece *C* with matched boards. The steering column is now put in place. This is shown in detail in Fig. 3 and 4. The two tapered blocks *J* are made from a piece of the 2 by 4-in. material and bolted to the platform with ¼-in. bolts. The bushing is made of 1-in. pipe with a flange coupling screwed on each end. The collars are also made of 1-in. pipe. They are fastened by drilling through the steering column and using ⅛-in. rivets. The arm *K* is fastened on by making a slot in it 1 in. long and ½ in. wide. The end of the rod is filed to fit the slot. When in place the rod end is riveted. The rod *L* is connected with the runner by a small angle iron similar to those used for the steering rods. The rod is hammered out to a diameter of ⅜ in. at the end and formed into an eye which is left partly open. The angle iron for connecting it to the runner is put on one end and the eye closed. The other end is then put through the hole in *K* and the angle iron bolted to the runner. The manner in which the steering wheel is fastened depends upon the type of wheel used, and therefore no directions can be given.

The seat may next be made. It is 6 in. high with a back 15 in. high, the boards being cleated together. The driving wheel bracket, crank and connecting link are shown in Fig. 5, 6 and 7. The width of the bracket and the width of the axle slot depend upon the wheel obtainable. The traction band for the wheel is shown in Fig. 8. This is made of 1½ by ⅛-in. iron, with small angles of the same iron riveted to it with the ¼-in. rivets. Be sure it fits the wheel tightly. Do not forget to have the chain in place before putting the wheel in the bracket. The rod *N* is held in place with cotter pins. Short pieces of pipe are represented by *P*.

The lever details and the rack are shown in Fig. 9 and 10. The rod connecting the lever with the crank is ½ in. in diameter. Make it the right length

so that when the lever is in a vertical position the drive wheel will be raised 3 in. from the ground. The brake pedal is shown in Fig. 11. Its position depends upon the side of the wheel hub chosen for the location of the brake lever. It is connected with the brake lever with the No. 6 wire.

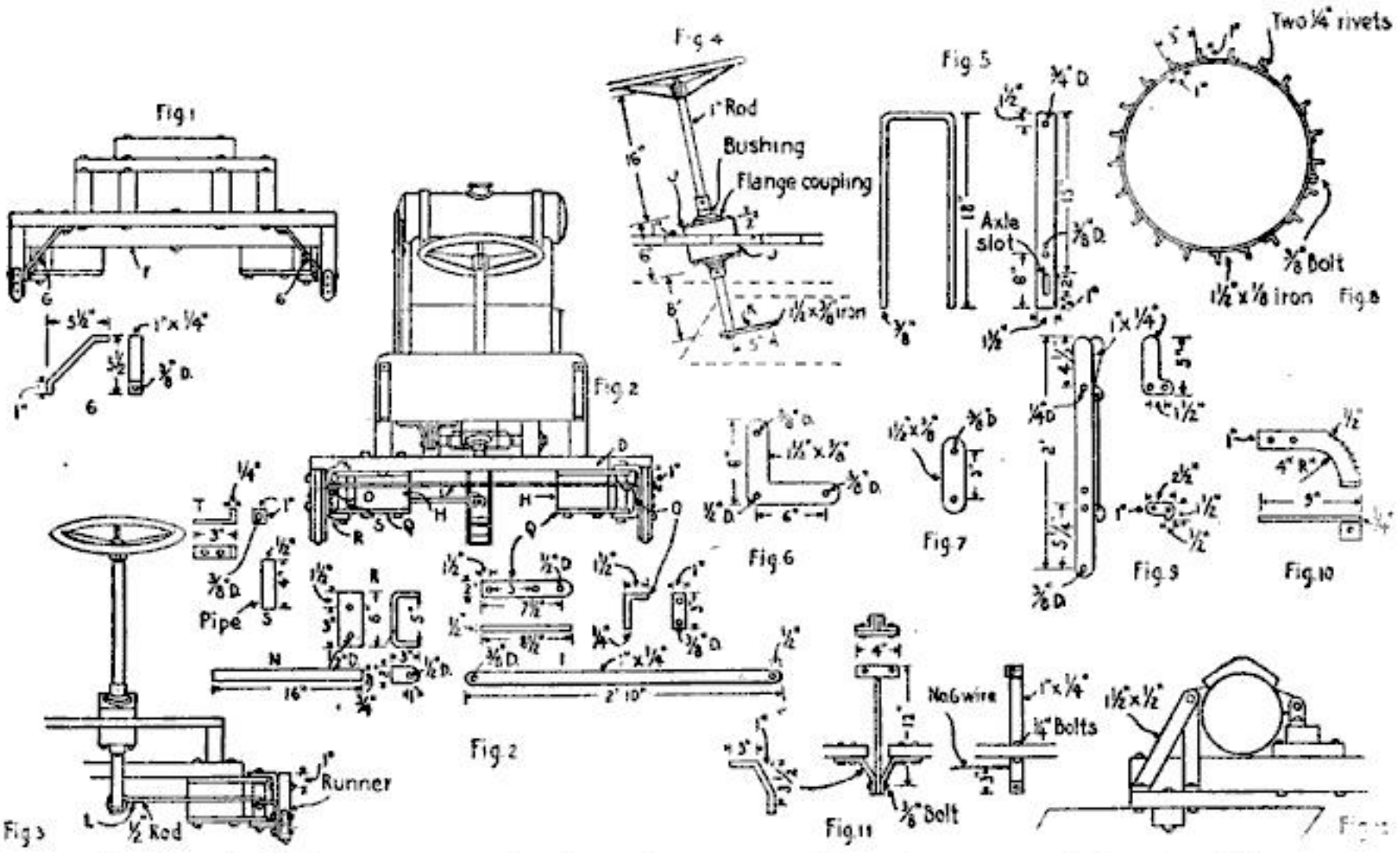
The engine can now be placed and lined up. This must be done carefully, as a very slight error may be the cause of a broken chain. As no two types of engines are mounted exactly alike, it will be necessary for the builder to devise a mounting for the particular kind at hand. One form of support, with perhaps a few alterations, should fit any ordinary engine, as shown in Fig. 12. The exhaust pipes may need to be bent to clear the engine supports. If there is no objection to noise they can be cut off to a length of 6 in. and the muffler discarded.

One way to arrange the engine controls is to run wires or rods from the throttle and magneto to small levers placed at the side of the seat. Means must be provided to keep the levers in position when once set. If the engine is equipped with battery ignition a box for the cells can be constructed under the seat.

Almost any kind of a tank may be used for the gasoline. The one shown was a motorcycle tank 6 in. in diameter and 20 in. long with compartments for both gasoline and oil. If one of this type is not obtainable, a two-quart can fastened to the seat back and connected with the engine by brass tubing can be used for the oil.

With some types of engines it may be possible to provide a crank for starting purposes, otherwise it will be necessary to turn the drive wheel over. If desired, the seat can be made wider to accommodate two passengers, although this will mean changing the position of the steering wheel and lever, and making the seat higher so that the rod from the lever will pass underneath.

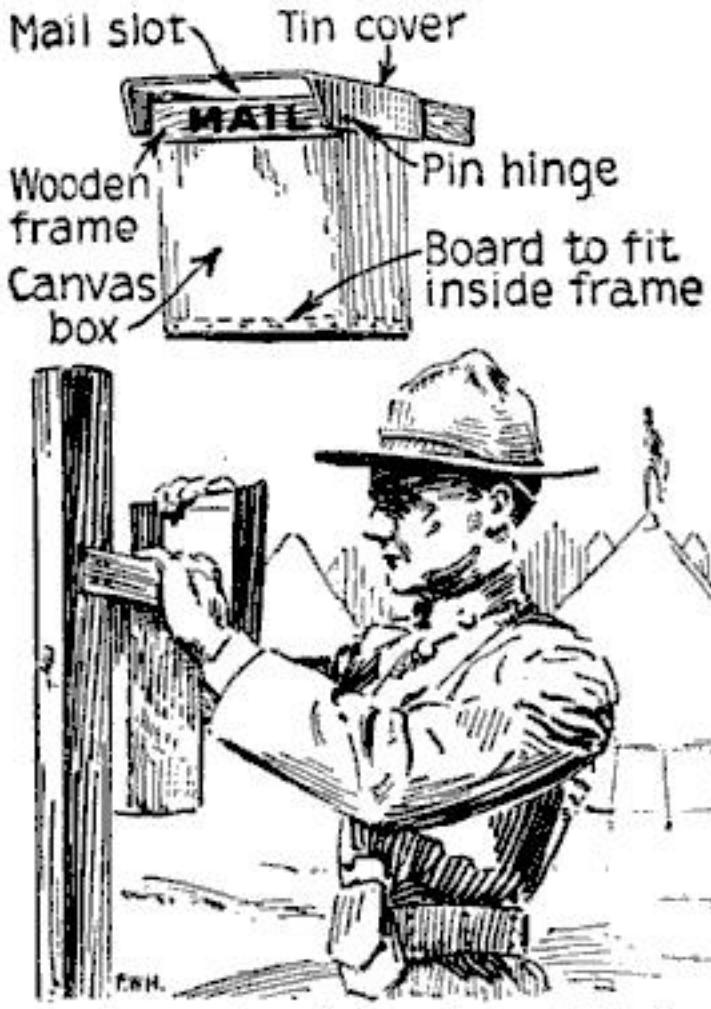
While the plans show an open sled, a hood for the front may be attached in order to avoid possible discomfort on a long drive. Such a hood can be made from sheet metal in any desired shape and attached so that it will protect the rider. The hood may be given a form similar to the ones used on automobiles, so that it will come up well over the driver's legs, and should have a windshield at the top to protect the face.



Details of all the parts entering into the construction of a motor sled to be driven by a motorcycle engine of nine horsepower mounted on the rear part of the frame

A Keyless Collapsible Letter Box for Army Camps

THE letter box shown below was originated by a mechanic in the Field Artillery of the U. S. Army. The upper part of the box consists of a wood frame to admit the upper part of



Letter box designed especially for use in the army camp. It is portable

a canvas bag. It is so constructed that when the metal cover is raised the canvas bag is released. Only army officers who are authorized to do so make the collections. The whole device can be readily taken down and packed for shipment.—DUDLEY HESS.

How to Make a Good Lining for Stove Fireplaces

IRON fireboxes, whether made of cast or wrought iron, usually deteriorate when the fires are kept constantly going for any length of time. To prevent this, the stove manufacturers supply their stoves with fireplaces having firebrick linings. Even these in time, due to the action of the heat, break into pieces, thus exposing the iron to the action of the heat. The following cement will take the place of the brick satisfactorily and it withstands heat. Take 6 parts of potters clay, 2 parts of plaster of Paris or cement if obtainable, 1 part of wood ashes, and 3 parts of carborundum in powder form. Mix all of the ingredients in the dry state and then add enough water to make a stiff paste. Apply it to the stove lining where the repairs are required. The carborundum in this mixture helps the lining to withstand the heat, since carborundum is an artificial substance, made under intense heat in an electric furnace.

After the lining is applied to the stove, let it dry for several days, if possible. When starting a fire for the first time, let the fire come to its maximum heat gradually. After that, any kind of firing may be done, as the lining, once having thoroughly dried, will keep in good condition for an indefinite time.—W. S. STANDIFORD.

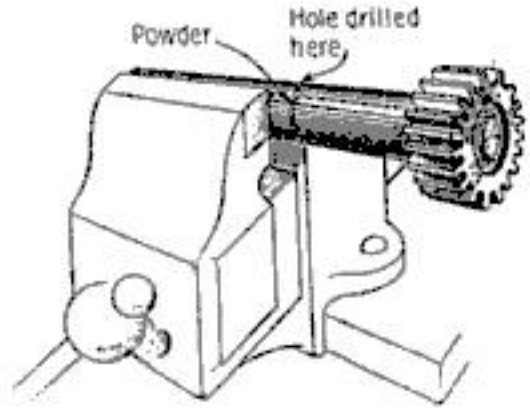
Homemade Copying Paper for Manifold Work

HOMEMADE copying paper, prepared by rubbing one side of common scratch paper with a very soft lead pencil, is more satisfactory for many purposes than carbon paper. For transferring map lines from field sheets to the office map, copying drawings, sketches, etc., it will be found very convenient.

Lines traced on a map or drawing made from such copying paper can be very easily erased. The erasure of the usual carbon-paper lines is not so readily accomplished.—PETER J. M. CLUTE.

Blowing a Pocket Gear From an Automobile Transmission

A POCKET gear on an automobile transmission having a thrust button, became cracked and it was necessary to remove it. The crack caused a burr in the hole that prevented the removal of the gear. The only method that could be used was the usual one of exploding powder back of the pinion stud. A small hole was drilled in the shaft to gain entrance to the space back of this stud and into this a quantity of powder was poured. The powder was ignited with a fuse and the pinion removed.—GEO. F. WEIHER.



Holding part in vise for blowing out the pinion

Simple Designs for Sheet Metal Working

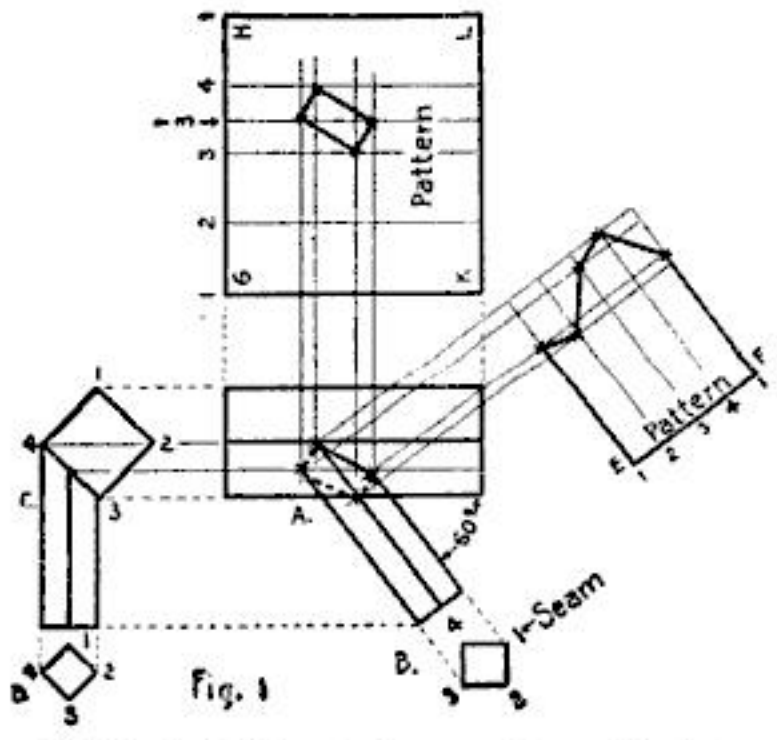
VIII.—Off-center tee joints, any angle, any shape

By Arthur F. Payne

Former Director of Vocational Education, Columbia University

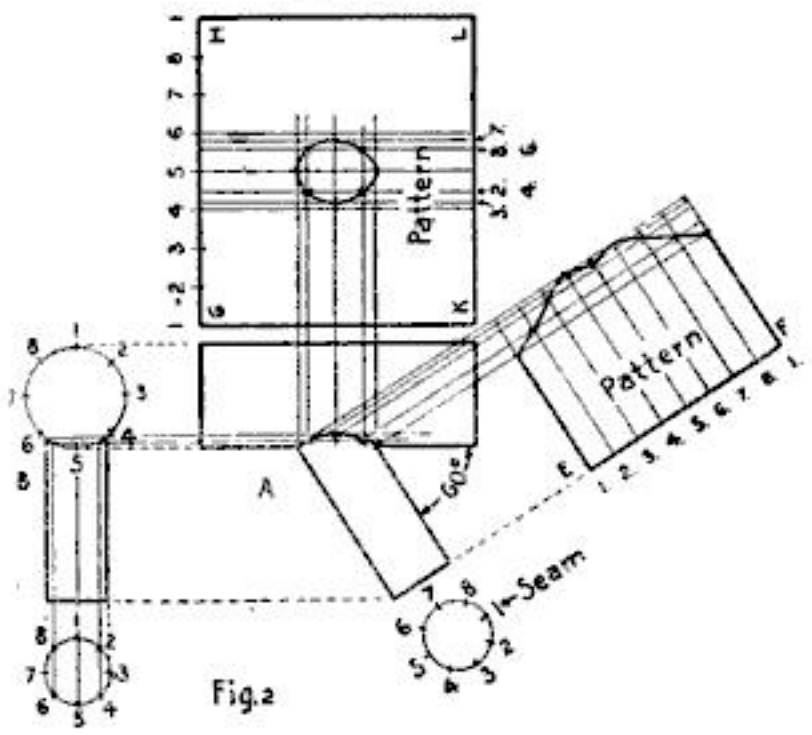
THE four problems in pattern development presented in this article will seem really difficult for the beginner; but those who have worked out the preceding problems, especially those of the last article, will find these easy. They merely require careful work; the methods of working are practically the same as for the preceding problems. Only two new steps in pattern development will be demonstrated.

The method of developing the patterns for the two square pipes intersecting at an angle of 60 deg. off center is shown in Fig. 1. The steps taken are as follows: Draw the front view, *A*, laying out the required angle as explained in last month's article; draw the bottom view of the small pipe *B*; number the four corners as indicated; draw the end view *C*; draw the bottom of the small pipe *D* of the end view and number the corners as shown, taking care to keep the numbers in the proper relation to the front view. Notice that the pipe has been turned, for this affects the position of the numbers.



Method of developing patterns for two square pipes intersecting at an angle

A new step in pattern drafting must be learned before we can develop the pattern for the small pipe. The front view *A* must be completed by showing exactly the shape of the joint where the two pipes come together. This is done in the following manner: Place a pencil on the point 4 on the bottom of the end view; follow the line upward until it touches the large pipe, then run the line



This problem is a little more complicated but is worked out in the usual manner

over to the front view *A* until it crosses the line coming up from point 4 on the bottom of the front view. Make a cross where these two numbered lines cross each other. Do the same with the other three numbers. Connect the four crosses with straight lines, and you will have an exact drawing of the joint. Notice that the two lower lines of this joint are drawn in dotted lines. This is to show that if the joint is made in metal these lines will not be seen because they will be back of the small pipe.

To develop the pattern for the small pipe, proceed in the usual manner as explained in previous chapters. Draw the base line *E*—*F*, transfer the distances from the bottom view to get the correct length, extend the lengths of the pipe from the front view until similarly numbered lines cross each other, one line coming up from the base line and the other coming across from the front view.

When the intersections of these lines have been marked with a cross, connect the lines with straight lines and the pattern will be complete. Make allowances for seams and laps.

To develop the pattern for the large

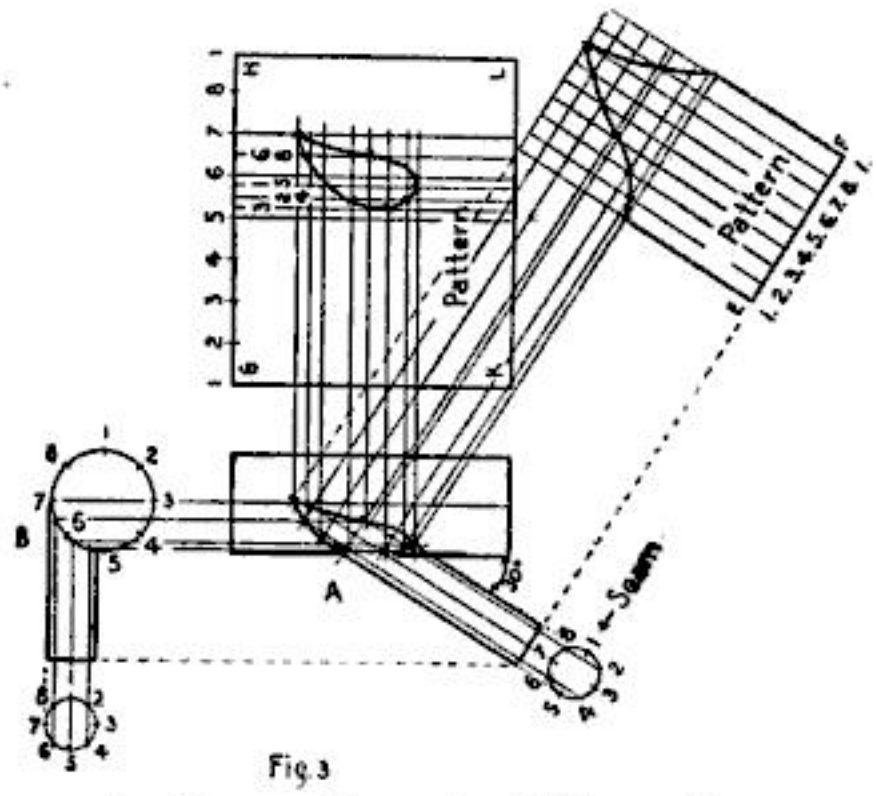


Fig. 3

In the working out of this problem two additional steps are taken

pipe proceed in the same manner as described in the last article. First draw the lines $G—H$ and $K—L$, obtaining the correct length by transferring the distances from the points on the end view as was done in the problems in the previous article; then run the lines up from the joint on the front view. Where the same numbered lines intersect, make a cross.

Now we come to the first new step required by this problem. No difficulty will be found with the lines 3 and 4, as it will be seen from the end view that lines 4 and 2 of the small pipe rest on them, but when you come up with lines 3 and 1 from the front view you will find that you have no place for them. By looking at the end view of the large pipe it will be noticed that lines 1 and 3 of the small pipe meet the large pipe exactly midway between 3 and 4 on the pattern. The point where the lines 1 and 3 from the front view cross this line marks the location you are trying to find, as shown in the drawing.

The second problem, Fig. 2, is worked out in a similar manner, but is made a little more complicated by the fact that it requires more extra lines to locate the pattern for the hole in the large pipe. Briefly, the steps to be taken are: Draw front view *A*, end view *B*; complete the front view *A* by drawing the joint. Do this in the manner described in Fig. 1, this being one of the two new steps mentioned in the first paragraph; develop the pattern for the small pipe, in the manner already described, drawing the base line $E—F$ and obtaining the correct length by transferring the distance from the bottom view; run the lines upward from the base line, and the lines over from the joint line, and where the same numbered lines intersect make a cross to indicate the pattern line.

To develop the pattern for the large pipe, draw the line $G—H$ and $K—L$, obtaining the correct length by transferring the spaces from the end view.

Now we come to another of the new steps in these problems. By looking at the end view you will notice that the hole in the large pipe will be between numbers 4 and 6, and that the hole does not rest exactly on the numbers. We also see that number 7 of the small pipe coming up from the bottom view meets the large pipe a short distance away from number 6. With the dividers, measure that distance and transfer it to the pattern as indicated by lines 6 and 7

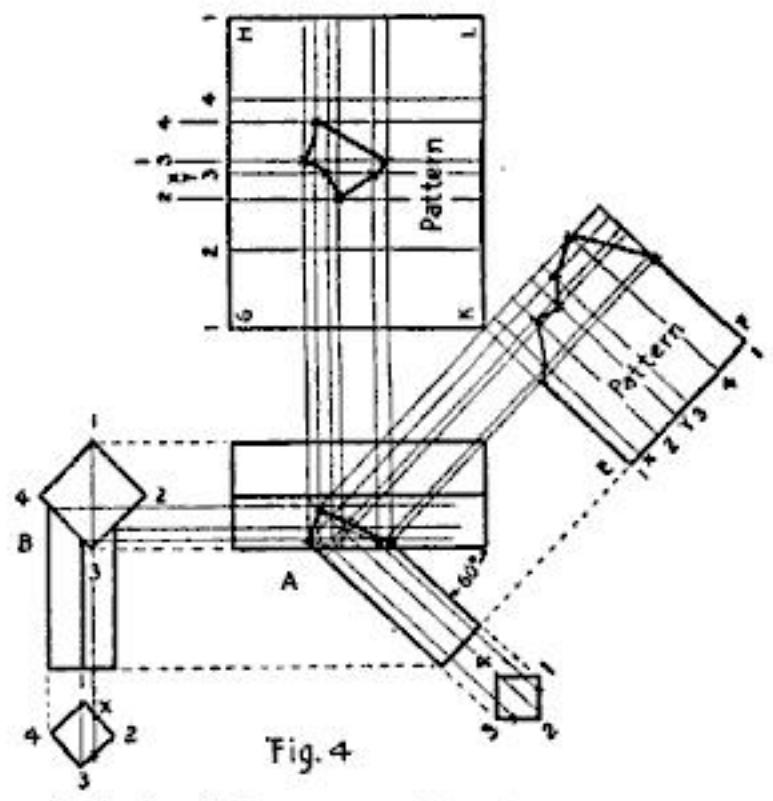


Fig. 4

A little different application of one of the new steps is shown in this problem

on the pattern. Lines 8 and 6 with 2 and 4 are a short distance away from 5 of the large pipe. Mark the distance on the pattern and number the lines with the same numbers as the spaces on the small pipe. Then from the front view

joint line run the lines up until the same numbered lines cross each other. Mark with crosses and connect with a curved line as indicated in the illustration, and the pattern is complete.

In the development of problem Fig. 3, the steps taken are exactly the same as the foregoing; in fact all the problems in this article and the previous one are based on the same principles, the only difference in method being the two new steps involved in the problems in this article.

In problem Fig. 4 we have the same principles and method with a little different application of one of the new steps. Draw the front and end view locating the joint line; develop the pattern for the small pipe as previously explained. When we come to develop the hole in the large pipe we will find that two extra points X— Y will be needed on the bottom view to indicate where point 3 of the large pipe comes in contact with the small pipe. We know that this point 3 will cause a change in the pattern of the small pipe in two places somewhere between points 1 and 2, also between 2 and 3; the exact distance can be found by measuring the space on the large pipe.

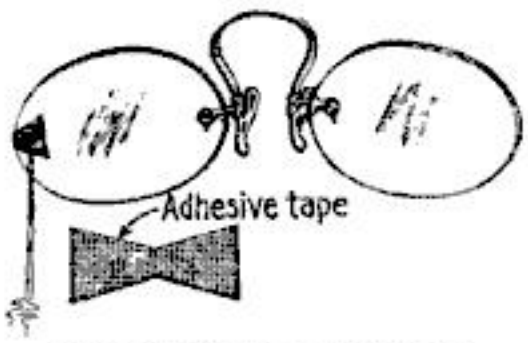
Proper Care of Shoes to Make Them Wear Longer

IT is possible to take such good care of your shoes that they will wear twice as long and look well to the last minute. In the first place, buy shoes that fit properly. Well fitting shoes will always outlast shoes that are either too tight or too loose a fit.

Remember that patent leather shoes and light weight footwear are not intended for hard service and consequently will not withstand rough wear. Be fair to your shoes and do not expect of them what they were never designed to give. All patent leather is likely to crack and no guarantee against this is made by the manufacturers of shoes. When the shoes are wet, be careful in drying them not to place them too near the fire, as they will dry out too quickly. This takes the life out of the leather and destroys its durability. Therefore, do not attempt to dry your shoes too quickly when they are damp. If your shoes are cleaned and dressed with proper dressing, they will wear twice as long. To keep them soft and pliable, there is nothing better than "neatsfoot" oil, which is inexpensive and can be bought at any leather or harness store. This oil is not a patent preparation, but is an oil that is used extensively by all harness makers to keep their goods in fine condition. Applications of this oil, say once a week, will keep the leather pliable and wear-resisting.—W. S. STANDIFORD.

Attaching a Cord to the Glass of Nose Spectacles

FOR a time I used a pair of borrowed nose glasses which had no hole for a cord, and fearing they would fall off and break I attached a cord temporarily by using a piece of adhesive tape. The tape was cut as shown and stuck to one glass, holding beneath it the loop of the cord.—JAMES M. KANE.



Shape of tape and manner of attaching to glass

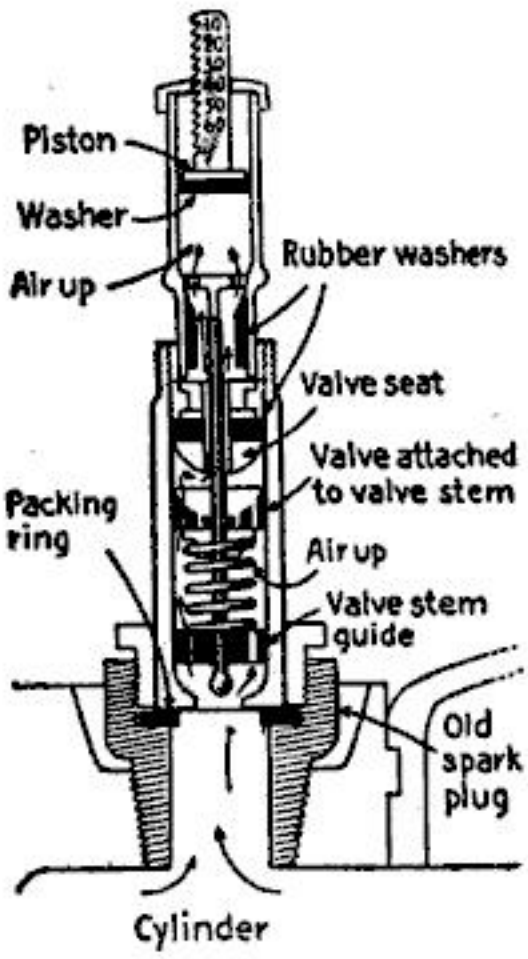
How to Engrave Your Name on Steel or Iron Tools

TO engrave your name on steel or iron tools, melt some paraffin wax in a tin can, old saucer or other suitable container; take a brush and coat the surface with the wax, then let it cool. When the wax hardens, draw the design or name on it with a scriber or other sharp instrument, taking care that the sharp point of the scriber goes through the wax and bites or scratches the metal underneath the wax. Then take a fountain-pen filler or a hard wood stick whittled to a point, and dip it into nitric acid, letting the drops penetrate through the name or design on the wax.

Be sure to cover all of the name with the acid, letting it remain on the metal for about five minutes, so as to get deeply-cut letters. Rinse the acid off with water, and heat the metal until the wax melts; then wipe it dry.

Testing Cylinder Pressure With an Ordinary Tire Gage

OWNERS of automobiles who want to know the amount of pressure in each cylinder of their engine, can obtain this information in a simple manner by following the example of Sterling Waggoner, of Putney, South Dakota. He takes a valve stem from an old inner tube and fastens it into a spark-plug base so that it is air-tight. Then he holds a tire-gage over the valve, while someone turns over the engine by hand. In a few minutes he determines which are his weak and strong cylinders.



Pressure gage attached to the cylinder head

In making the device, all that is necessary is a threaded connection to fit the spark-plug hole in the cylinder, into which is fitted the extension barrel holding the pressure gage. The air pressure forces up the gage valve which, as is generally known, remains at the highest point. This can be read at any time after making the test until the gage is again set.

Solution for Removing the Rust from Drawing Instruments

THE following method of removing rust from drawing instruments is only applicable to those pieces that are spotted with rust and not to those that need regrinding. A saturated solution of tin (stannous) chloride should be prepared, and the instruments permitted to remain in the liquid overnight. They are then rinsed in running water, and rubbed with a chamois skin until thoroughly dry. The rust is removed by the reducing action of the tin chloride. Polishing powder is necessary to restore the original luster of the instrument.

Portable Scaffold for Putting on Vertical Siding

ON this scaffold a workman putting on barn siding, or doing similar work, can remain in a perfectly comfortable position and nail two or three pieces of siding to three nail ties without having to shift. After this he moves his scaffold into position for nailing the next set of boards by simply sliding it along the top of the upper nail tie as shown in the illustration.

The scaffold is made of the following material: One board 1 in. by 12 in., long enough to more than reach across the three nail ties; one piece 2 in. thick by 12 in. long and just a trifle wider than the top of the nail tie, to be securely nailed to the upper end of the board *A;* and another piece 2 by 4 by 12 in., nailed to this in such a way as to provide a hook by which the scaffold can be suspended to the upper tie. One piece of board 1 by 12 by 16 in. is securely fastened and braced at some convenient

The scaffold seat is hooked over the upper plate on which it slides to position

place near the lower end of the long board to provide a platform upon which the workman may stand or sit comfortably while he is nailing on the siding.—JESSIE L. BLICKENSTAFF.

How to Shoot Birds on the Wing

You aim where the bird isn't, so that he and the bullet meet at the intended spot

By Edward C. Crossman

THERE is one great rule in successful shotgun shooting—don't shoot at the bird; shoot where he's going to be. There are exceptions of course, but as a rule shooting directly at a flying object with the shotgun means a miss.

Don't shoot at the bird. Aim at the spot where he is going to be

Probably the most exasperating set of figures in the world, and the most useless in actual practice, are those which pertain to the time of flight of a charge of shot; the bird's speed and its exact distance from the gun. Mathematically simple is the problem of putting the center of a shot charge precisely over a bird flying at a given distance and at a given speed. It is simple enough to calculate the distance a bird will fly in a given time and then to calculate the time the shot charge takes in getting to the bird, and so the distance the gun must be pointed ahead. The little joker lies in the fact that in real life at least two unknown quantities enter into the problem—first the distance to the bird, second the speed of the bird. So quickly does the whole thing happen that the shooter has no time to find out the distance to the quarry, while the speed of birds varies. So successful shooting becomes a matter of experience, governed by a sort of sixth sense which is eventually acquired by the veteran scatter-gunner.

If the bird is a crossing bird and flying 40 miles an hour at a distance of 40 yd., then he's traveling in round numbers 60 ft. per second, and in a tenth of a second, 6 ft. A charge of shot of size used for upland birds, takes .14 sec. to travel 40 yd. In .14 sec. our bird travels 8.4 ft. There is also a slight delay after one's brain signals the finger to pull, which amounts to one .01 of a second and up, or say six inches more travel by the bird. So the hapless wight firing directly at his bird, misses him by nine feet, less a foot or two for the spread of the pellets which might have gotten the bird had the charge passed within a foot or two of being right.

So comes the necessity for either holding ahead or swinging ahead of any bird going at an angle to the line of fire, and the necessity for throwing the gun muzzle ahead of the bird regardless of its direction, distance or speed. The spread of the pellets—giving a killing circle 35 in. across at 40 yd. in the case of the full choke gun and more in guns not so much choked—takes care of some error in holding, else few of us would ever hit a bird; but the man who depends on the spread of his shot to connect is going to believe after a bit that his "pattern," the spread of the shot, isn't much wider

Where to aim at a bird that has approached and is passing the hunter

than an ordinary small-sized saucer.

The good shot usually swings ahead of his bird and keeps on swinging as he presses the trigger. Some men swing

Where to aim with the second shot when the birds have passed and are going away

up from behind and swing very rapidly past, pulling when they feel they are far enough ahead. Others throw the gun up ahead of the bird and swing along at about the speed of the flyer. The man who swings rapidly by the bird has to lead it less than the man who swings at bird speed, because the speed of his gun-swinging carries him farther ahead than he realizes by the time the charge is out of the barrel. Few men can hit consistently by holding ahead of a bird—holding the gun still at a point they consider correct. The slightest delay in pulling the trigger means a miss—a tenth of a second means six feet, in our hypothetical reasoning. A delay while the gun is swinging, however, means nothing, because the muzzles are still keeping ahead of the flyer and so are aimed at about the right spot for shot load and birdie to intersect.

While many men learn early the necessity for the generous swing ahead and lead on the crossing duck, they fail to grasp the fact that the quail, apparently angling off so little that they can hit it by shooting right at it, is really moving fast either to the left or right. Therefore they shoot right at Brother Quail who is buzzing off to the left and forward, and the shot load hisses by the bird to the right. The aim was correct for the spot where the bird was—but not where he was when the shot got there.

Making a hit by a direct aim at a bird flying straight away from the hunter

Clay bird shooters have the same experience when they shoot right at the clay angling off from the straight line to the gun. To hit the angling bird, therefore,

If a bird rises and flies very low—just skimming away—the gun should be aimed so as to be well over or in advance of the bird. The tendency is to wait too long to shoot

the wise gunner puts the muzzle a foot or two to the left or right of the bird, as he may be angling from the straight

When the bird is ascending the hunter shoots well over him to make sure of a hit

line. No swing is possible, because the distance from the straight line is slight.

The soaring bird is another deceiver of the simple huntsman. No old duck shot needs to be told how much one has to hold over the duck which leaps from the reeds and darts almost vertically for the blue voids. I remember shooting about one box of shells at a covey of quail, broken up and lying just over the crest of a rocky ridge. The birds simply dropped down the ridge like stones, and most of the box of shells went while I was thinking that I had to hold lower and lower below the dropping bird to make the shot charge intersect his flight. When I saw two or three feet of daylight 'twixt the muzzle of the gun and the bird above, then the bird usually quit flying and went tumbling down the slope.

All of this holding where the bird isn't and all this swing prove necessary merely because of the relatively slow flight of shot, which has about the velocity of sound for a short distance, and then less as the range grows longer. If we could give shot the sustained velocity of our Government rifle, hitting with the shotgun would be a matter merely of holding correctly on the bird — and so "like shooting fish."

As I have said, applying the mathematics of the case to the actual shooting is difficult, because of the unknown factors in the problem; but it is possible to get an approximation of the right distance ahead necessary for the various ranges, and so avoid the inclination to shoot behind the bird, which is the most common fault of the shotgun man.

A load of No. 7 shot flies like this over the various ranges:

Range	Time of Flight	Average velocity	Velocity at end of range	Lead necessary for bird flying 60 ft. per sec.
20	.0611 sec.	1050	860	3 ft. 8 in.
25	.079 "	1000	800	4 " 9 "
30	.0985 "	950	740	5 " 11 "
35	.1194 "	900	700	7 " 2 "
40	.14 "	875	650	8 " 6 "

The speed of birds is usually overestimated. British experiments with accurate time-measuring apparatus years ago showed that pheasants fly little more than thirty miles per hour in the open, while the buzzing partridge, like our own quail, flies less than this. The duck, down-wind, is the fastest thing our gunners have to shoot at, but it is doubtful

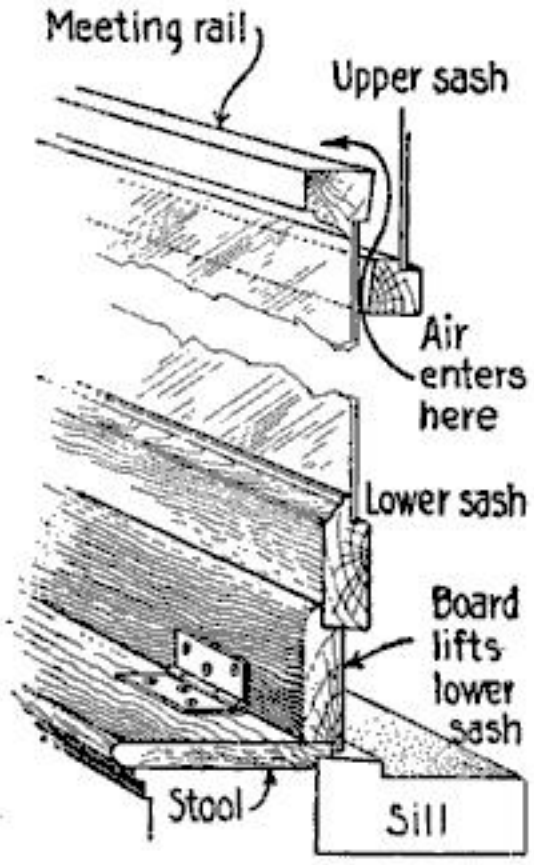
The hunter does not aim at the spot where the rabbit is but at where he is jumping

if they get up over 60 miles an hour despite all the yarns of the returned huntsman.

The same general rules which are given for shooting birds on the wing also apply to rabbit hunting. The rabbit usually gives the hunter only the slightest glimpse of him in passing an open stretch of ground, so that some rapid calculations must be made in order to hit him at the next clearing.

A Simple Cold-Weather Ventilator for the Window Sill

FOR very cold days, when drafts would be objectionable, the simple ventilation device shown in the drawing will be appreciated by everyone. Fit a board 1 in. thick, 1½ in. wide and 4 in. long by hinges to the stool of the window, rebating the top so that when the board is set vertically it will hold the lower sash of the window up. This permits the air to come in between the upper and lower sash without draft, while the opening at the bottom is closed with the board. The bottom of this board, as will be seen, is also rebated to fit over the stool.



Hinged board under lower sash to raise window for ventilation

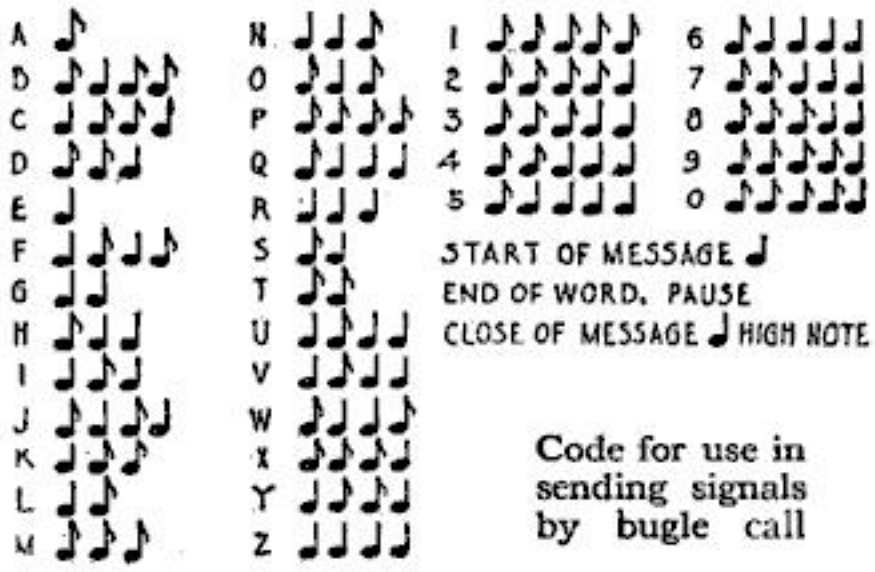
When the window is to be closed the board is pulled over into the flat position on the window stool. The hinges should not be set flush into the stool and board, because extra play is needed for it to fall into position. The ventilation afforded between the two sashes is sufficient for ordinary purposes on cold and windy days.—HAROLD V. WALSH.

Joining Pieces of Rubber by the Use of Heat and a Glass Rod

IN the chemical laboratory small pieces of tubing are often discarded because a satisfactory method of uniting them to form a larger piece is not known. With a glass rod which fits the tubing a very good joint can be made. The rod should first be wound around with paper and then inserted in the tubing. Before applying the tubing to the flame, powdered soapstone or talcum should be sifted through the tube to prevent the rubber from adhering to the rod or paper.

Using a Bugle to Transmit Telegraph Signals

ALMOST every person is familiar with the idea of sending messages by the wigwag system of flags, but here is a code by which messages may be transmitted within the range of a bugle



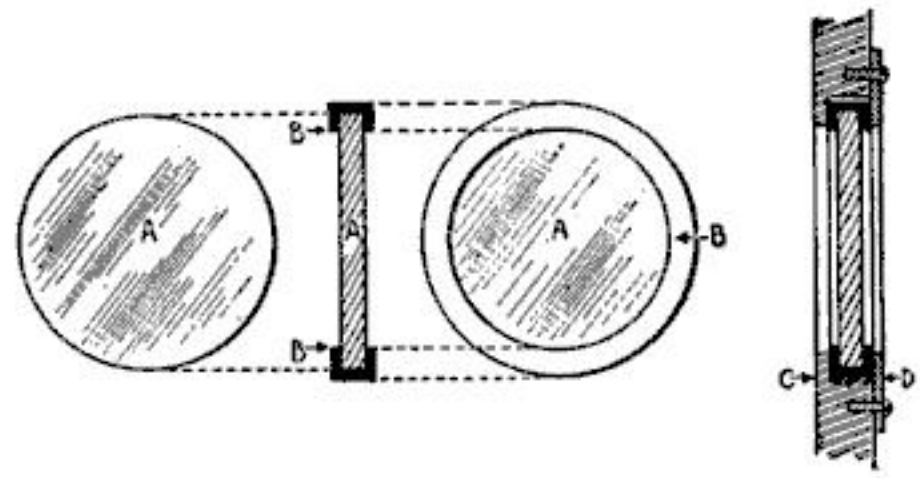
Code for use in sending signals by bugle call

sound by quarter and half notes. There is not anything difficult about the code and it can be learned almost as quickly as the bugle calls.—THOMAS MCHUGH.

A Waterproof Mounting for a Circular Piece of Glass

A VERY good method of securing a circular piece of glass in a metal frame, and at the same time making it waterproof, is shown in the illustration.

The circular piece of glass is shown at *A*, and at *B* is shown a rubber band stretched around the glass, dividing it evenly on both sides. At *C* the iron case in which glass is set is shown, and *D* shows the metal rim, screwed down by machine screws, which exerts a pressure on the rubber band, thereby securing and waterproofing the glass. The rubber band surpasses putty, felt, etc., in neatness and durability.—WALTER B. WEBER.



A rubber band stretched over the edge of the glass and pressed in the metal rim

The Amateur Electrician

And Wireless Operator

Resonant Annunciator to Operate on Alternating Current

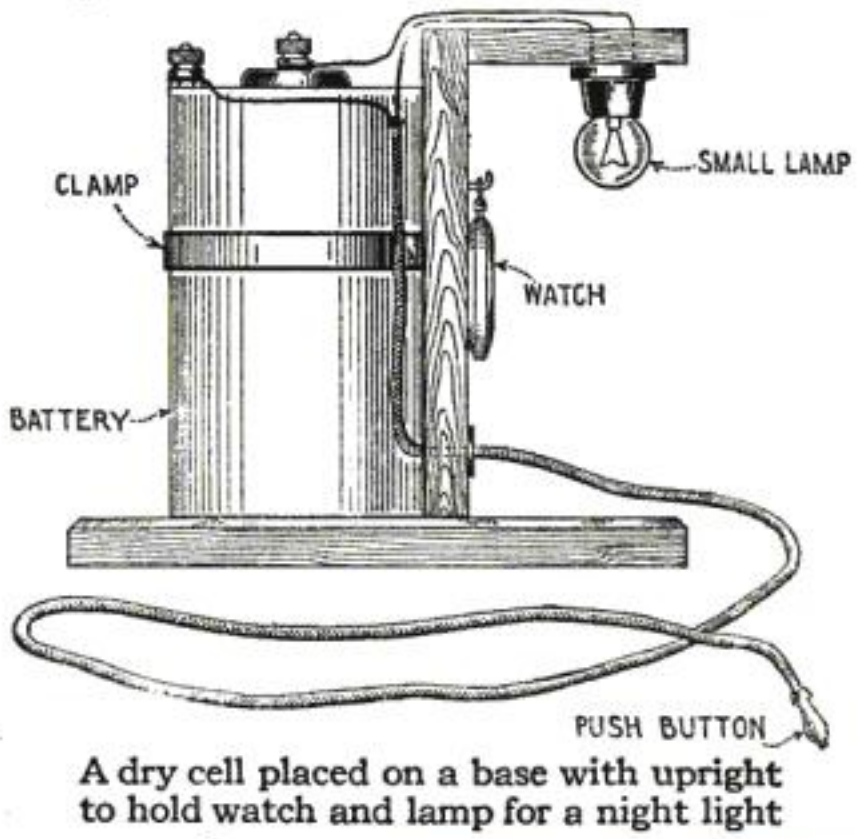
HERE is a method of constructing an annunciator to operate on a 110-volt alternating current that is very simple, yet efficient. There are no sparking contacts in this annunciator; nevertheless it admits of a wide range of tone adjustment and gives forth a powerful buzzing note that is exceptional because of its unusual resonance, its extremely low pitch and enormous volume. The pitch may be regulated to a higher frequency and smaller volume, which may be necessary when the far-reaching, low, powerful note is not desired, as may be the case when there is someone ill in the house or where for any other reason it is necessary to minimize the noise of the instrument.

The annunciator consists of nothing more than a 75-ohm watch-case receiver. The cover of the receiver should be unscrewed nearly all the way when the low pitch is desired. By screwing the cover on tighter, the pitch is raised. To secure best results, the receiver should be mounted at an angle slightly off vertical, or in other words, with the face of the receiver-cover tilted downwards. A 60-watt lamp or something equal in resistance to it should be placed in series with the annunciator in order to lower the amperage of the current passing through it and thus serve to protect its windings.

The device will consume hardly any current at all and an ordinary push button may be used; but the wiring and insulation should be much heavier than for ordinary battery annunciators. It is, of course, readily understood that the buzz produced is the effect of the rapid alternations in the current.—JOSEPH BRAFF.

Making a Night Light of Battery Cell and Miniature Lamp

A SIMPLE, yet efficient night light can easily be constructed by following the instructions outlined in the accompanying illustration. If the necessary materials are not at hand, they may be purchased at any electrical store. The base and the upright are made of wood, and fastened together with two flat-headed screws. A felt pad, cut to shape and pasted on the bottom, will prevent the polished surfaces from being scratched.



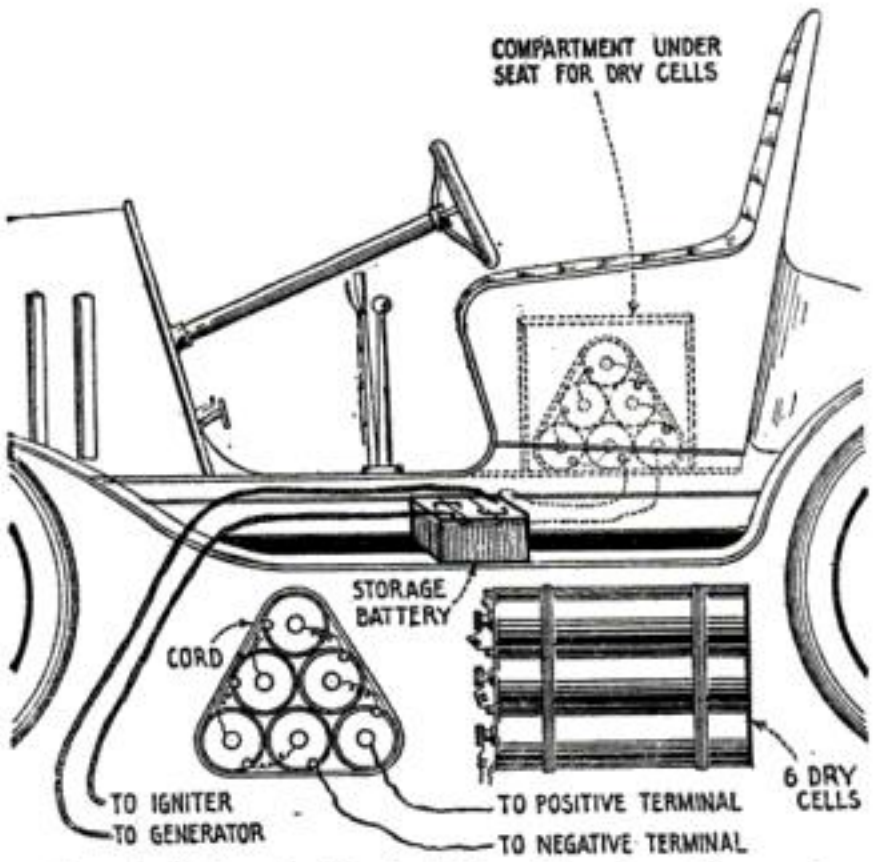
A dry cell placed on a base with upright to hold watch and lamp for a night light

The battery is held in place by a wire bound around it and attached to a staple on either side. The lamp, preferably a 2½-volt tungsten, is connected in series with the button and battery. For running the wires from the lamp to the back of the board, insulated staples should be used.

A twisted No. 20 lamp cord is used. Its length depends upon the distance between the bed and the article upon which the night light is to be placed. The sketch shown above makes the construction clear.—H. NEUHAUS.

An Emergency Battery for Starting an Automobile Motor

AT least 50 per cent of the modern automobiles use battery ignition. As this system sometimes gives trouble, even in the most expensive cars, I devised a method for producing an emergency current as shown in the illustration. This consists of six dry cells securely tied together in a triangle shape and wired in series with a 4-ft. length of well insulated copper wire attached to each of the negative and positive terminals. These wires are used to make connections with the storage battery terminals for starting the motor; then they are disconnected.



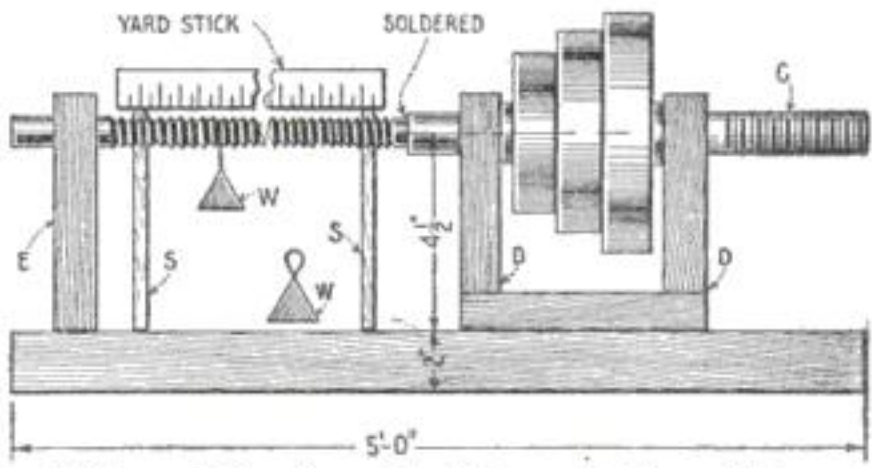
A set of dry batteries placed under the seat to aid in starting the automobile motor

The batteries will last a long time for this emergency work. If the storage battery gives too much trouble, remove the filling caps and make sure that the liquid is ½ in. above the top of the lead plates. Should the level be below this point, add enough distilled water to make up the deficiency. Keep all the battery and wire terminals bright by scraping them with a sharp knife about once a month, and make sure that there is no short circuit in the dashboard switches and that no battery wire or other wire is chafing against any metal to produce a short circuit. In this way a battery may be kept at its highest efficiency.—P. P. AVERY.

A Winding Machine with a Revolution Counter

THE winding machine shown in the drawing is of service for winding various types of coils, transformer "pies," etc., in the amateur's shop, or wherever there is no small screw-cutting lathe. The novel feature of the machine is the simple method employed for determining the number of revolutions the spindle makes during the process of winding a coil.

A piece of round stock, *C*, ½ in. in diameter and 12 in. long, is threaded 3 in. of its length at one end, and has a 3/16-in. hole drilled in the opposite end to a depth of ½ in. A three- or four-step set of cone pulleys is made fast to the center of *C* by keying or with a forced fit. The spindle is mounted in bearings upon standards *D* as shown, and the spindle unit thus assembled is permanently fastened to a baseboard 2 in. by 6 in. by 5 ft. A piece of 3/16-in. round rod 3 ft. 4 in. long is then threaded with a die, cutting 32 threads per inch for its entire length with the exception of about 2 in. at one end. The stand *E* is made and fastened to the baseboard at the point shown, and acts as a bearing for one end of the threaded rod. The end of the rod left unthreaded is now inserted in its bearing in the standard *E*. The opposite end is inserted in the hole drilled in the end of



A threaded rod on the lathe spindle registers the exact number of turns of wire on the coil

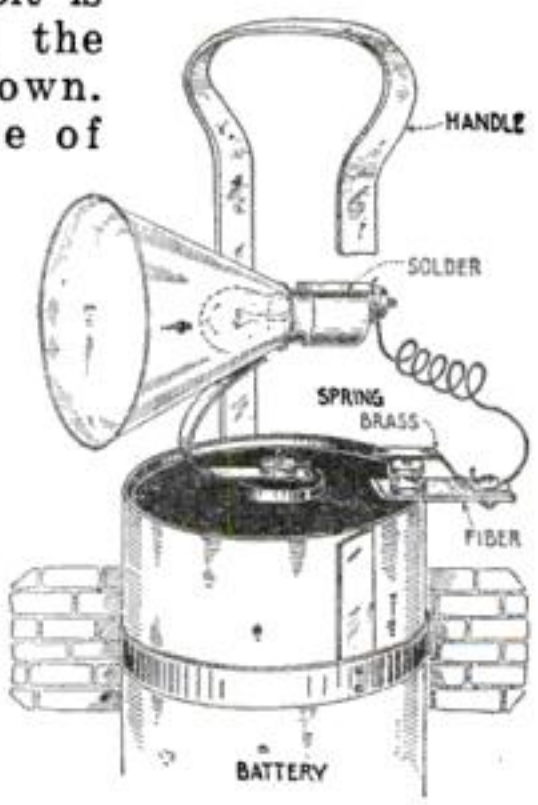
C, to which it is soldered. A yard stick is mounted in line with the threaded rod and directly above it, and is held in place by two strap-iron standards *S*. A loop of fine iron wire is passed around the threaded rod, the ends are twisted together and a small lead weight is fastened to the twisted ends as shown

at *W*. The machine is now completed and ready to operate.

It is to be driven by a small motor, bolted so that the spindle turns away from the operator. The rider *W* is placed at a point directly below the zero on the yard stick, which should be at the left end if a right-hand thread was used. When the motor is started the spindle revolves, the rider follows the thread and moves along the threaded rod. When the rider has moved a distance of 1 in., 32 revolutions have been made by the spindle and a corresponding number of turns wound upon the coil under construction. When the rider has moved the full length of the yard stick, the spindle will have made 32 times 36 = 1152 revolutions. The rider is then replaced at zero and the winding and calculations continued.—H. W. OFFINS.

A Homemade Electric Lantern for a Dry-Battery Cell

THIS lantern is constructed from an ordinary dry-battery cell 2½ in. in diameter and 6 in. long. and a tin funnel 2½ in. in diameter. The spout of the funnel is removed and a small electric bulb of one volt is fastened into the funnel as shown. From a piece of heavy galvanized sheet iron cut a strip ½ in. wide, having a length sufficient to make a clamp and carrying handle. Make a small thumb-switch of a piece of 1/64 by ¼-in. spring brass. This should be located near the carrying handle.

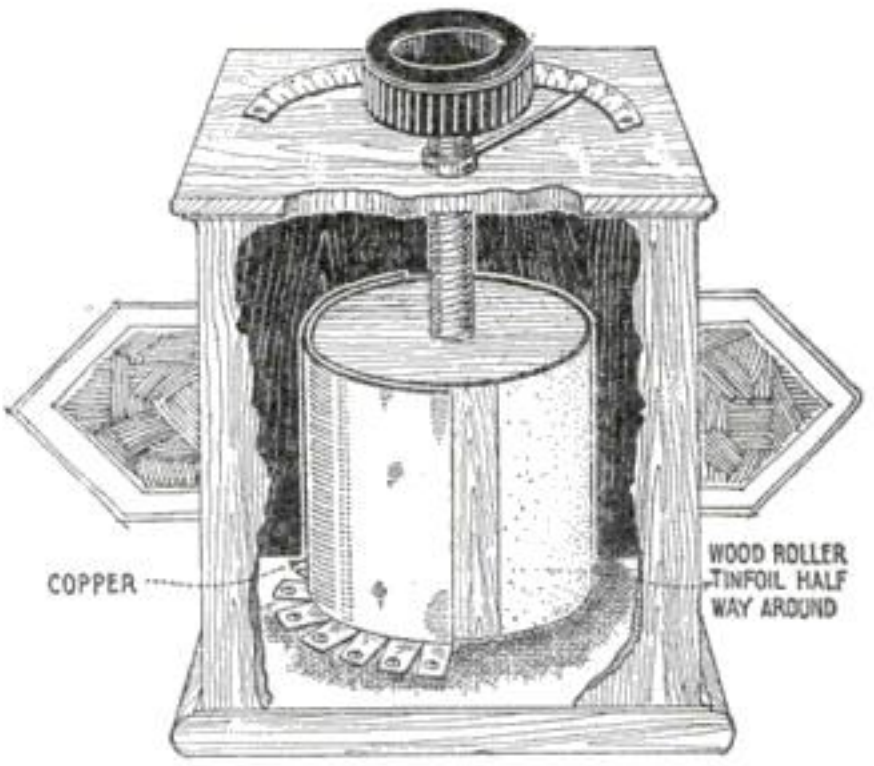


Handle attachment and connections to battery

An old electric bulb from an automobile side lamp may be used, or a one-volt lamp with a brass screw socket and a porcelain base will answer the purpose. Secure the funnel reflector to the battery with a brass clamp, and when the battery is used up unscrew and connect with a fresh one. This provides a powerful and handy electric lantern which is as easy to carry as the old barn lantern and which is more satisfactory.—P. P. AVERY.

An Easily Constructed Variable Condenser of Brass and Tinfoil

MAKE a wooden roller 3 in. in diameter and 4 in. long, as shown,



Wood roller with tinfoil half way over the surface to vary the capacity of the condenser

and mount it on a shaft, which may well be of ⅛-in. brass rod. Thread one end of the shaft so that a wooden knob and metal pointer may be screwed in place. Coat one half of the surface of the cylinder with tinfoil, and solder a fine wire connection from the foil to the shaft. The shaft should project about ½ in. from the cylinder at one end and about 1½ in. at the other (which carries the knob and pointer), according to the size of the cabinet to be used.

Make a half-cylindrical piece of thin sheet brass or copper a trifle larger than the wooden cylinder, bending out supporting feet as shown. When these two parts are finished, the condenser may be assembled.

When the knob is turned, more or less of the tinfoil is presented to the sheet of brass or copper and consequently the effective capacity is varied. Connections are made with the shaft and the fixed sheet of tinfoil and with the brass or copper shell which is around the outside of the roller.—THOS. MILLSBAUGH.

Making an Electrically Heated Blue-Print Dryer

AT times atmospheric conditions make drying of blue prints very slow, and when it is necessary to hurry up such work some means of drying by heat must be employed. The illustration shows an electrically heated chamber for the purpose. The dryer inclosure consists of composition board applied to a light frame of wood 2 in. square, of the dimensions given.

The top piece of the box is perforated to cause a circulation of air. A wire *A* is stretched from corner to corner on both upper ends of the sides to provide a support for the dryer frames. These frames are constructed as shown at *B*. The frames are built of furring strips and cheesecloth, drawn tightly and tacked to one side to make a surface having considerable absorption. As many of these frames may be used as may be required for the inclosed space.

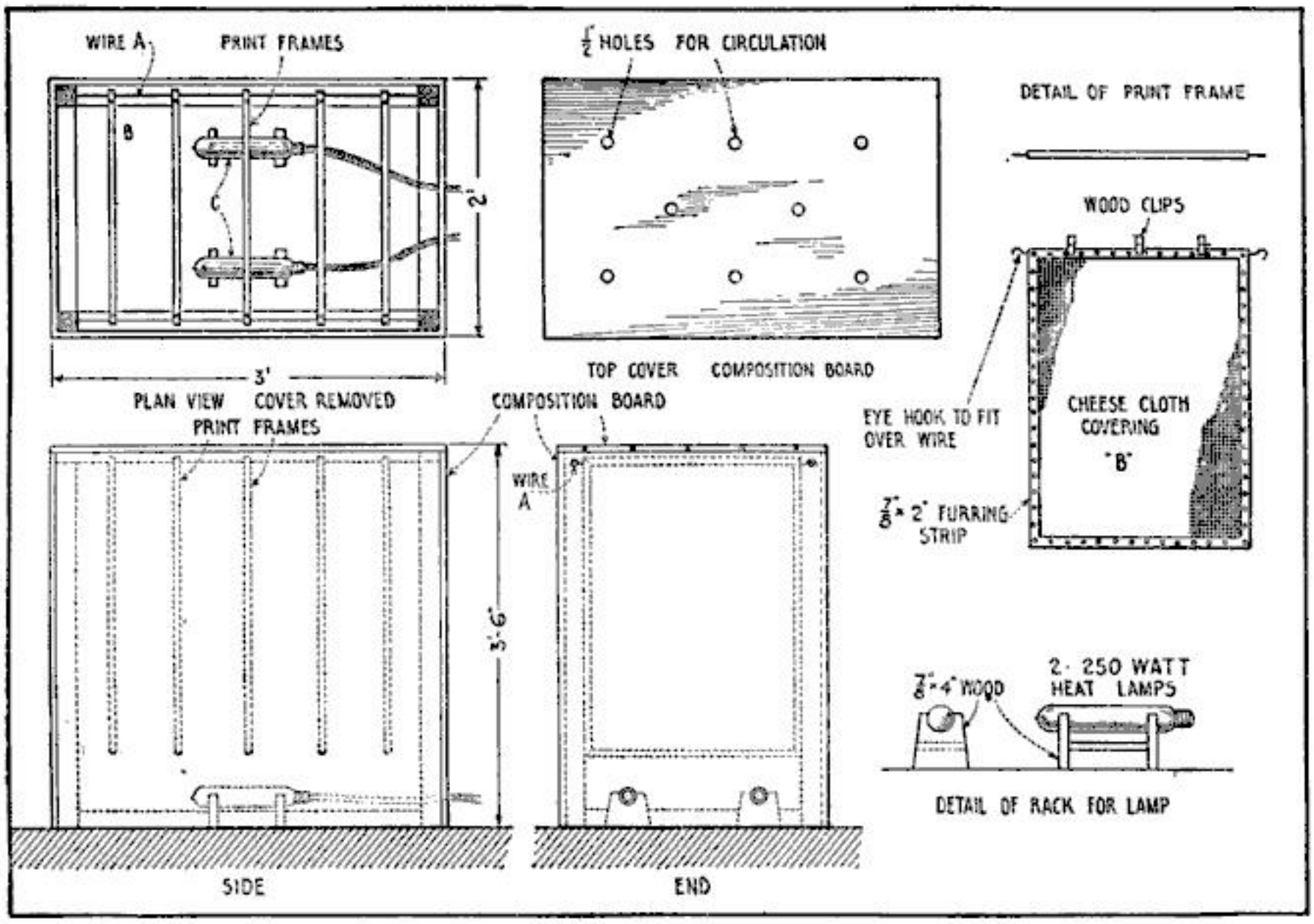
At the base of the inclosure two racks are made to hold two 250-watt heating lamps. Metal or asbestos should be used in the notches to avoid the possibility of the heat from the lamps burning the wood. Over-drying should also be guarded against.—J. E. CAHILL, JR.

How to Insulate the Ends of Chair Posts

A CHAIR that is provided with insulation against electrical surges is invaluable for safety and efficiency in electrical operations, such as wiring, telegraphy, or high frequency work. Most chairs may be very easily adapted to such a use.

Four large common green glass insulators, such as are used on the crosstrees of telegraph poles, should be obtained. The four feet of the chair should be made to fit tightly into the holes of the insulators.

Since the hole in the bottom of the insulator is threaded, the insulator should be twisted on with a rotary motion. Besides insulating the chair, these insulators will serve in the place of domes for the legs of the chair.—JOSEPH BRAFF.



A drying box made of composition board with frames covered with cheesecloth on which blue prints may be hung over electric heating lamps and dried quickly

Electrical Devices and How They Work

Primary Battery Cells—I.

This article is the first of a series on electricity, each one of which is complete in itself. Some interesting experimental problems are illustrated and very explicitly described

By Peter J. M. Clute, B. E.

THE agency which comes into action when a circuit containing an electromotive force is closed is called electric current. This current flow is analogous to the flow of water in pipes, or over the surface of the earth. Such a flow of water takes place only when from any cause, a difference in pressure exists between two points, or when the water is at different levels. When either of these conditions exists, the flow takes place in a certain direction; namely, from the higher to the lower level, the amount of flow being dependent upon the obstacles in its path. Electric currents, likewise, flow only in obedience to electrical pressure, and the quantity of current flowing is dependent upon the resistance to the flow offered by the circuit.

A simple primary cell is shown in Fig. 1. It consists of a glass jar nearly filled with a dilute sulphuric acid solution, into which are placed a plate of zinc and one of copper. While the ends of the wires connected with the plates remain separated, no current flows; but an electrical pressure exists, as can be readily shown. As soon as the ends of the two wires are brought into contact, a flow of current commences. It is the high resistance of the air between the two terminals which prevents the flow of current in this case, just as the presence of a closed valve in a waterpipe prevents water flow.

The current itself cannot be seen as it flows through the wire, but its effects are evidences of its presence. A current flowing through a thin wire will heat it; flowing through water and other liquids it decomposes them; flowing near a magnetic needle it will cause it to deflect. All these phenomena cease at once when the current is interrupted, either by breaking the circuit or by separating the acid around one plate from that around the other by a non-conducting partition.

The direction of current is said to be from the zinc to the copper inside the cell and from copper back to zinc in the external circuit. In all cells the plate, or terminal, from which the current flows, is called the positive pole, and the terminal toward which the current flows in the circuit is the negative pole.

From the cell shown, Fig. 1, which is the simplest of all forms, a very insignificant current is given. If several cells

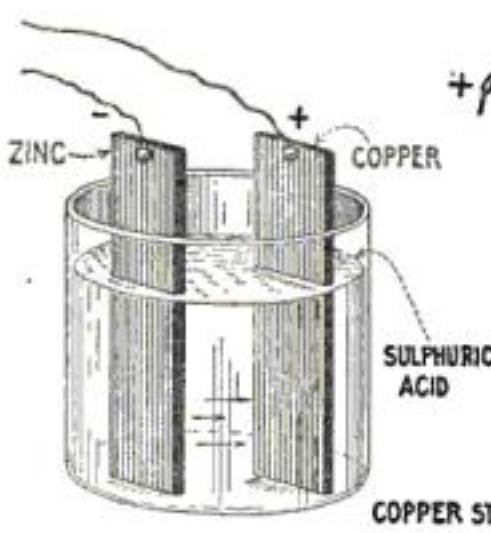


FIG. 1

FIG. 2

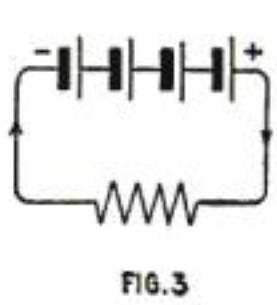


FIG. 3

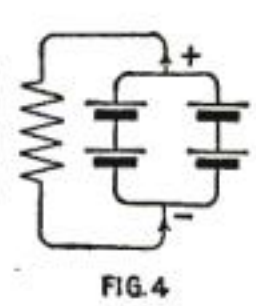


FIG. 4

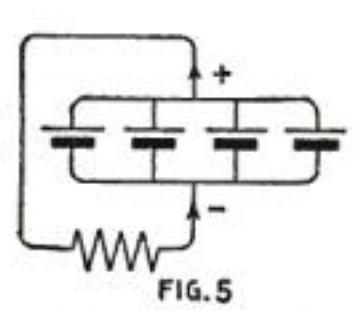


FIG. 5

The simplest form of battery, the primary cell, and the gravity cell with wiring diagrams

are coupled together, as conventionally indicated in Fig. 3, 4 and 5, a considerable current is obtainable. In this representation, the long thin lines indicate the positive plates and the short thick lines the negative plates.

The term "battery" is applied to a number of cells grouped together either in a series or in parallel and should never be applied to a single cell. Representa-

tive battery groups are shown in Fig. 3, 4 and 5. For all ordinary work, the method of connections in Fig. 3 is employed, where the voltage of the battery is four times as great as that of a single cell. If the same four cells are grouped as in Fig. 4, the voltage will be but twice that of one cell, but the strength of the current will be twice that of Fig. 4. When arranged in parallel, as in Fig. 5, the E. M. F. will be equal to that of one cell, and the current four times that obtained when the cells are connected in series. The voltage of a number of cells in series is equal to the voltage of one cell multiplied by the number of cells.

The voltage obtainable from any cell is independent of its size or of the distance between the plates. For any given cell, however, the current is directly proportional to the size of plates, and inversely to the distance between them. Thus, the distance between the plates affects the current only, as it increases the internal resistance.

The resistance of a number of cells in series is equal to one cell's resistance multiplied by the number of cells. When arranged in parallel the total resistance is equal to the total resistance of one of the cells divided by the number of cells in parallel.

Primary cells are divided into two classes. One class is suitable for continuous work only, and will quickly run down unless connected in the circuit; this is the closed-circuit type. The other will rapidly deteriorate when continually used; this is the open-circuit type.

The best known of the closed-circuit type is the gravity cell, shown in Fig. 2. The positive pole, or cathode, consists of copper located at the bottom of the jar, and the negative pole, or anode, of zinc crowfoot arranged at the top. Both are immersed in a copper-sulphate solution. This type is suitable only for such work as telegraphy, or wherever small currents are used, since the internal resistance of the cell is great.

Open-circuit cells are much more extensively used, including nearly all the different makes of dry batteries. The so-called dry battery consists of an outer cylindrical cup forming the zinc electrode, which is lined with thick absorbent paper and packed with a pulverized manganese dioxide and carbon mixture surrounding the central carbon rod. The whole is saturated with ammonium chloride solution and sealed with pitch to keep it from drying out.

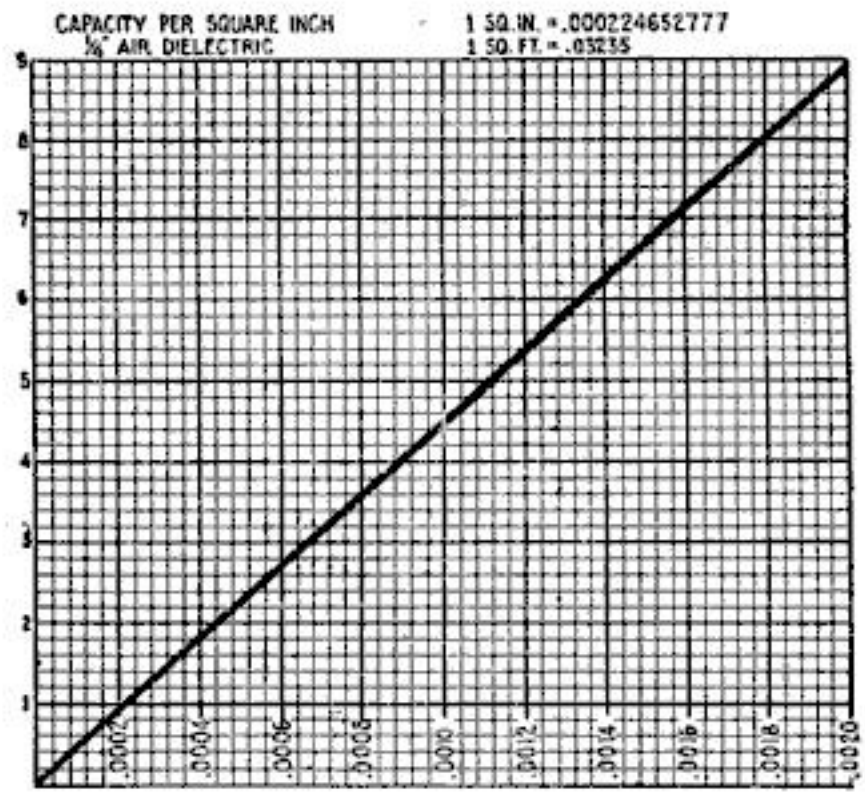
Apart from dry cells, the Leclanché cell is most used. In this cell the cathode is of carbon immersed in sal ammoniac solution, and the anode is a bar of zinc immersed in the same liquid, but insulated from the carbon. Such cells can deliver a strong current for a short time. If left in circuit, however, they will run down in a short time. These cells are universally used for bell and telephone work, and in places where intermittent current is desired, as they consume no energy when not in use.

(*To be continued*)

A Simple Method for Determining Condenser Capacity

A QUICK and easy method of calculating condenser capacity by simple arithmetic, will appeal to all experimenters, and particularly to those of the younger class who have not reached that stage in the study of mathematics at which they are able to handle formulae. The curves shown here may be used.

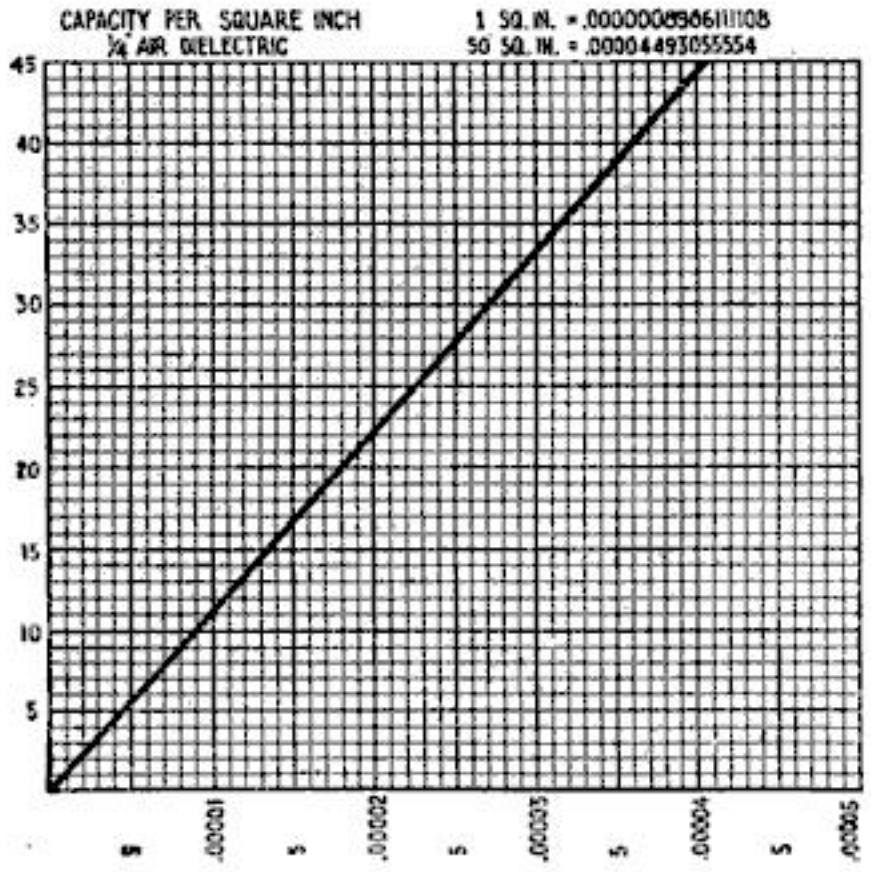
As an example of their use, suppose it



The curve shows that a condenser will need almost 10 square inches of active dielectric

is desired to build a mica stopping condenser of .002 mfd. capacity, and the mica available for use as the dielectric measures 8 mils in thickness. From the

first curve it is observed that a condenser of this value having air as a dielectric 1 mil in thickness will require 8.9 sq. in. of active dielectric. But the mica is 8 mils thick. A condenser with an 8 mil



This curve is useful for calculating the capacity of glass plate transmitting condensers

air dielectric and still having a capacity of .002 mfd. would require 8.9 x 8 = 71.2 sq. in. However, the specific inductive capacity or dielectric constant of mica, as obtained from a standard text book is 6.64; that is, the ratio of the values of capacity of two identically constructed condensers, one with air dielectric and the other mica, is as 1 to 6.64. Therefore, 71.2 ÷ 6.64 = 10.72 square inches of active dielectric of 8 mil mica will be required for a condenser of .002 mfd.

The second curve will be found useful for calculating the capacity of glass plate transmitting condensers, and is used in the same manner.

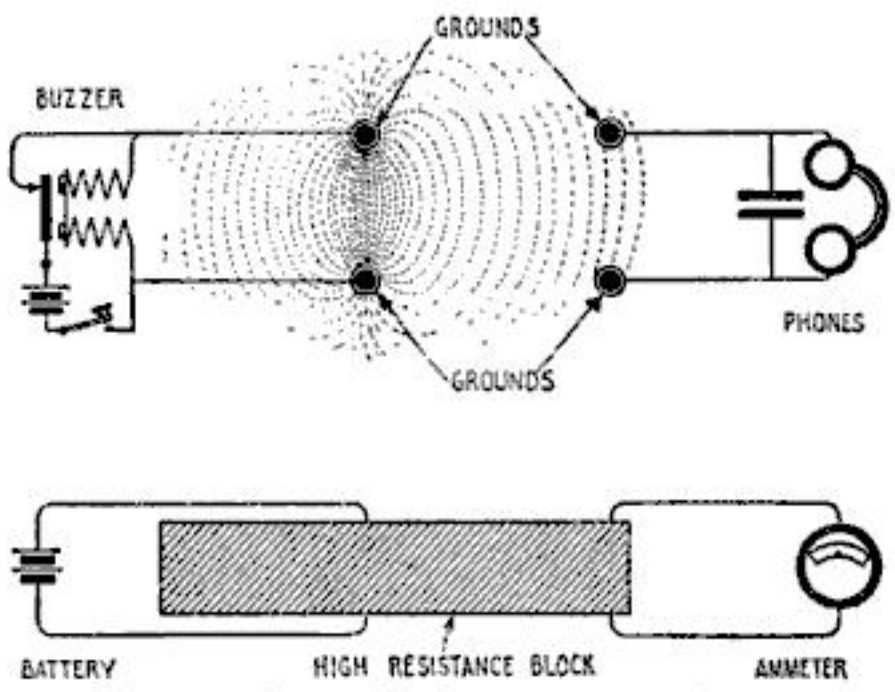
A Fire-Proof Whitewash that Will Not Rub Off

A FIRE-PROOF whitewash can be readily made by adding 1 part silicate of soda—or potash—to every 5 parts of whitewash. The addition of a solution of alum to whitewash is recommended as a means to prevent the rubbing off of the whitewash. A coating of a good glue-size, made by dissolving ½ lb. of glue in a gallon of water, is good when a wall is to be papered.

Telegraphing Through the Ground by Wireless

BECAUSE the Government, for good and sufficient reasons, has put a ban on amateur wireless stations, it does not follow that all your activities must stop. There is much left that may be done. Your radio efforts can be diverted to communicating by ground wireless, which is almost as interesting. You will do well to put in a little of your spare time reading and studying more about the "stuff" that electricity is made of, the nature of wireless radiations, and the like.

Telegraphing through the ground is permitted by the Government, since high tension apparatus need not be used, at least not in their normal capacities. A



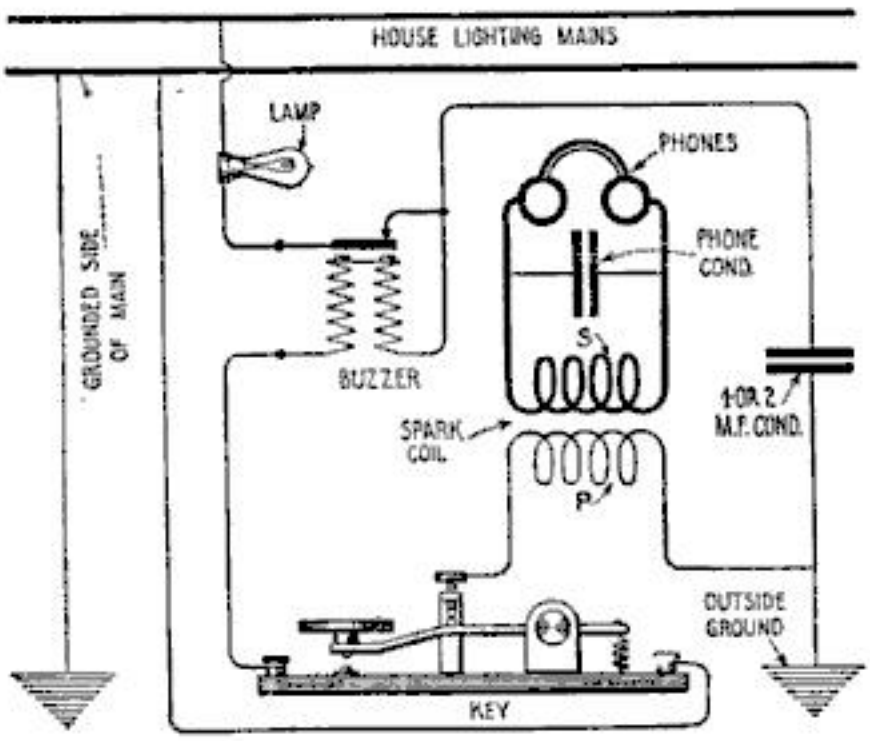
Currents from the buzzer are conducted through the earth just as they would be through a shunt to an ammeter

simple buzzer, supplied with a current of half an ampere, is sufficient in this system to send a distance of from one to forty miles under favorable circumstances, but this distance is constantly being increased by amateurs who are already experimenting.

The present importance of ground telegraphy is not generally appreciated by America and her Allies. For all we know, the Germans may be using it now. If we can send forty miles with it through the highly-resistant earth, considerably greater distance can be covered through water. The announcement by two Virginia men that the system can be successfully employed for communicating between submarines is therefore of the utmost significance. Notwithstanding the simplicity

of the apparatus, it may be outdistancing all other sub-sea methods in range.

The principles upon which ground wireless telegraphy works are interesting. Ordinary electric current conduction is the operating factor, instead of radiation as in radiotelegraphy. The coils of the sending buzzer are connected with two grounds, as shown in the diagram. At every break of the circuit caused by the buzzer armature, the inductive discharge that ordinarily causes a spark at the



A complete, practical break-in system to start with in "through-the-ground" operation

armature contacts, discharges to the earth. The relative high voltage sends an electric current from one plate to the other.

It is obvious that we have not merely a narrow conductor between the plates, but a conductor which is as big as the earth! The result is that, while most of the current going from one ground to the other takes the straight-line route, a good part of it spreads out. The lines of flow in reality appear just like the lines of force which are shown by iron filings between two opposite magnetic poles.

Some of these far-spreading streams of current will reach the buried plates of the receiving station. The leads of the receiving station will "tap" these streams—which are highly pulsating—and a telephone will detect them.

This at once explains why the line going through the plates of one station should be parallel to that going through the grounds of the other. Another fact that is found by experience is that the further the grounds of each station are separated, the louder will the received signals be. This second phenomenon can be explained by referring to the diagram. Here an ammeter is connected with a battery through a metal block of high resistance. This block stimulates the action of the ground between the two wireless stations. It is very much like an ordinary shunt that is put across an ammeter. The greater the resistance of such a shunt, the less current will go through it and the more will go through the ammeter.

Now, in placing the grounds of the stations farther apart, we increase the distance across the theoretical block. Hence, the metal that the current must cross, and the metal's resistance will be increased. The ammeter will then receive more current. For just such reasons, when the actual grounds are buried farther apart, the telephones will receive a larger current.

In practice, you should space your grounds at least twenty feet apart, though it would be much better to have them separated over fifty feet. The neatest and most efficient hook-up to start with is shown in the diagram. Here the house lighting mains are utilized, with a bank of lamps to cut down the voltage. The arrangement enables you to use as much current as the size of the buzzer wires will permit. It also enables you to use the grounded side of the mains instead of one which you would otherwise have to make yourself. If your house is not wired, however, as many as a dozen dry cells, or an equivalent storage battery, may be employed. You will have to make two outside grounds for your station by burying a few pipes in the ground.

By providing your key with a third contact, a simple break-in system is obtained. The telephones shown in the receiving circuit are high resistance wireless receivers. In conjunction with all such high resistance telephones, your spark coil should be used as a step-up transformer. That is, the secondary of your coil should be connected with the receivers and the primary with two grounds.

Of course, should you have a good pair of telephones which are of low resistance, you may use them without the spark coil by connecting them directly with the grounds.

Electrical Wizardry at Home

Some weird effects that you can obtain with a Tesla coil and some of your apparatus

By E. R. Thomas

TO begin with, if you have an oscillation transformer the secondary will make a suitable primary for a Tesla or Oudin Coil.

To construct a Tesla coil that will give a 10 to 12-in. spark, procure a tube 4 in. in diameter and 16 in. long. This may be made of two tubes 8 in. long and joined together as shown in Fig. 2. Some cereals come in tubular containers which will answer very well for this purpose. The pieces *A* and *B* are of wood; shellac is used to join the parts together. Avoid the use of nails in this construction.

After applying two coats of shellac to the secondary tube, wind it closely within ½ in. of either end with double cotton-covered No. 25 wire. Then give two coats of shellac to the windings, being sure the first coat is absolutely dry before applying the second.

The base and uprights should be made of well seasoned wood which should also be shellacked. Make the dimensions to suit the individual requirements. Fasten four glass push-pins to the base as shown

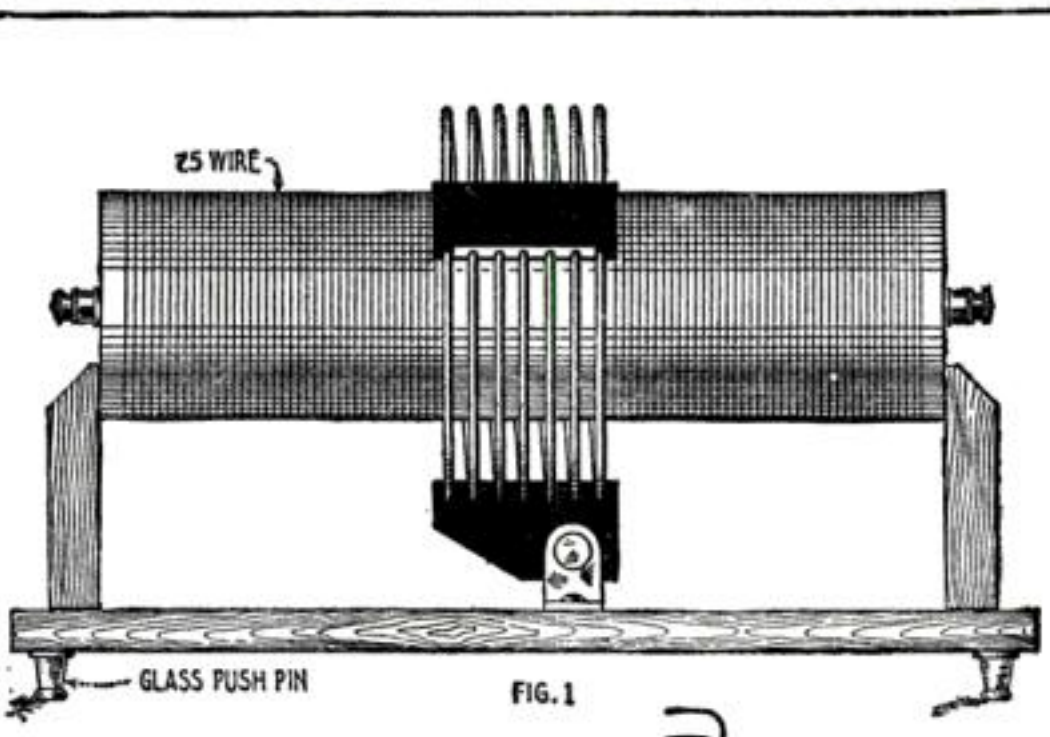


FIG. 1

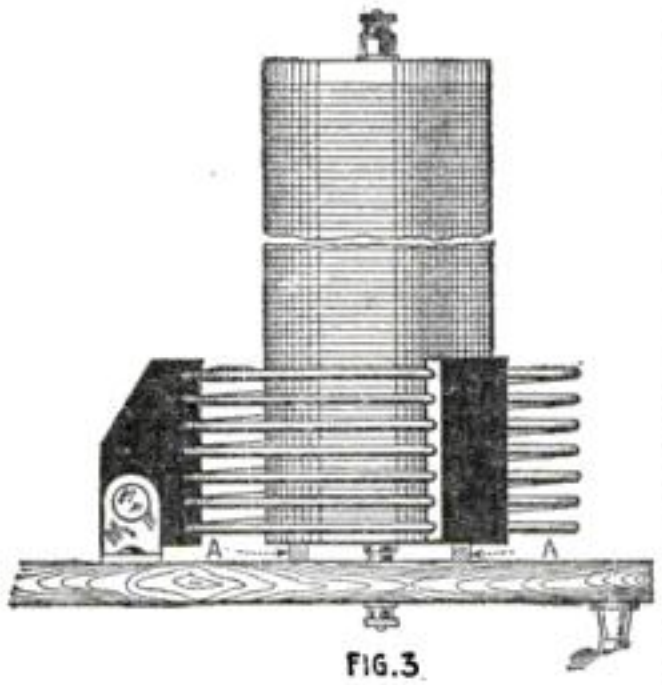


FIG. 3

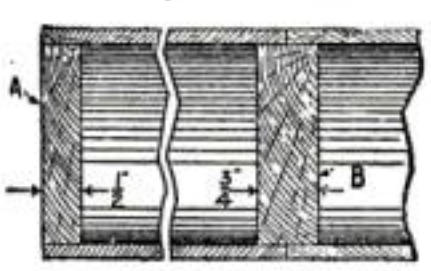


FIG. 2

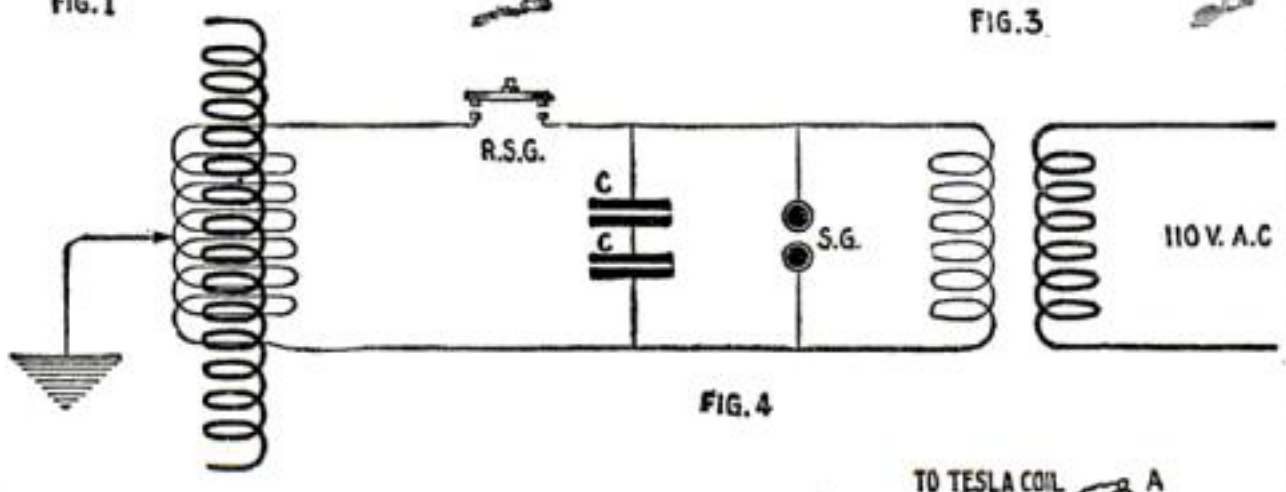


FIG. 4

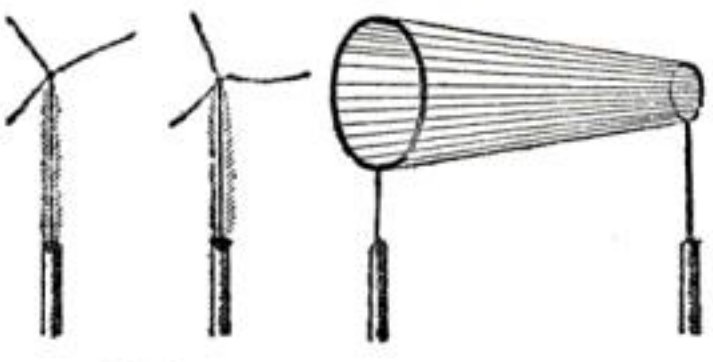


FIG. 5

FIG. 6


FIG. 7


FIG. 8

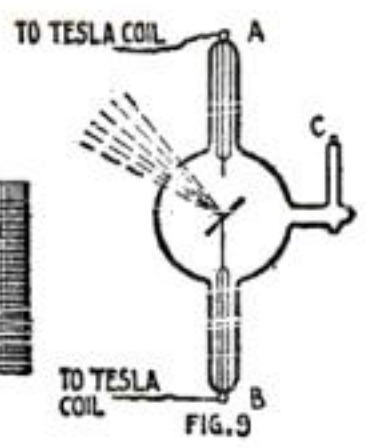


FIG. 9

Details in the construction of a Tesla or Oudin coil and diagram of the hook-up for the experiments shown in the lower part of the illustration. These experiments as well as X-ray photographs may be made by the use of this coil

in Fig. 1. These serve as insulators.

In Fig. 3 is shown how the above described Tesla coil with a few alterations can be converted into an Oudin coil. The three small blocks *A* are used to support the secondary.

The hook-up for a Tesla coil is shown in Fig. 4, and the abbreviations used are as follows: R. S. G., rotary spark gap; C and C', condensers; S. G., safety gap.

Various experiments are shown in Figs. 5, 6 and 7. The two wires in Fig. 5 are connected with the binding posts of the secondary and are left to project vertically in the air. Long streamers wave about, producing a weird effect.

The experiment in Fig. 6 produces a cone of light. Two wire hoops, one 12 in. in diameter and the other 3 in. in diameter, are connected with the secondary, and the lead wires are so bent that the hoops are separated 5 or 6 in.

When a gap is made as shown in Fig. 7, a spark 10 to 12 in. is obtained. Of course all these experiments should be made in the dark.

If two metal disks about 1 in. in diameter are provided and one attached to each of the connection leads, a brilliant flow of light will be produced from their edges. For another experiment, suspend two metal rods from the ceiling or other support so that they will hang about 2 in. apart. Connect these to the leads. Sparks will start at the bottom and run to the top, making a ladder of light.

When the coil is converted into an Oudin coil the bottom binding post is connected with the lower turn of the primary; otherwise the connections are the same as for the Tesla coil, as shown in Fig. 4. A brass ball 2 in. in diameter, Fig. 8, should be screwed on the top binding post of the secondary in place of the thumbnut. One of these may be obtained from an iron bed.

An interesting field for high frequency experimenting is in connection with the X-rays. The bulb, Fig. 9, is connected with the secondary leads of the Tesla coil at *A* and *B* on the bulb. The wire *C* is the vacuum regulator, and is operated by bending it over near *A* so a spark will jump while the tube is running.

Good X-ray photographs of the hand or other objects may be made with this apparatus. To take an X-ray photograph, load a plate holder with one plate only, then expose it, holding your hand or other object against the side of the plate holder nearest the plate. The X-rays penetrate the light-proof slide with ease. The time of exposure can only be determined by trial. A good printing negative can be made by holding the plate holder 5 in. from a 6-in. tube and exposing it for 2 minutes.

An Electric Torch Made of Bichromate Solution in a Bottle

ONE of the most novel of the many electric torches recently invented, consists merely of a wide-mouthed bottle having rods of zinc and carbon inserted through a rubber cork. These rods project down into the bottle for about one-third of its depth. On top of the cork a small electric lamp is mounted, similar to those used in ordinary electric torches. Connections are made between the lamp and the zinc and carbon rods.

A mixture of water, bichromate of potash, and sulphuric acid is put into the bottle, and stands at a level of about 1 in. below the end of the zinc and carbon rods when the bottle is upright. When the bottle is turned upside-down, it becomes what is known as a bichromate cell, a well-known type of cell for producing small quantities of electricity for electric bells and similar devices. The electric current produced when the solution surrounds the zinc and carbon rods is strong enough to light up the lamp, and the apparatus becomes an electric torch. The cork of the bottle must, of course, be made perfectly water-tight.

Square bottles with large round mouths, such as are used for pickles and similar products, are very suitable for these torches, as they can be laid down on their sides when light is required.

Lacing Belts Through Eyeleted Holes in the Leather

The life of a belt may be lengthened considerably, if instead of the customary slits in the belt, eyelets obtained from old shoes are substituted through which to pass the thong in lacing. These will prevent the thong from tearing out under the strain when drawn tight.

Wireless Work in Wartime

VI.—Atmospheric or static interference, and how to secure practice in operating through it

By John L. Hogan, Jr.

WHEN the student has learned to send and receive correctly, and has had sufficient practice in reading wireless messages through artificial "station" interference, he is ready to take up the most important (and perhaps most difficult) problem that confronts the radio operator. This is the copying of received messages in spite of the interfering sounds produced by natural electrical disturbances, and called "static," "atmospherics," "X's" or "strays."

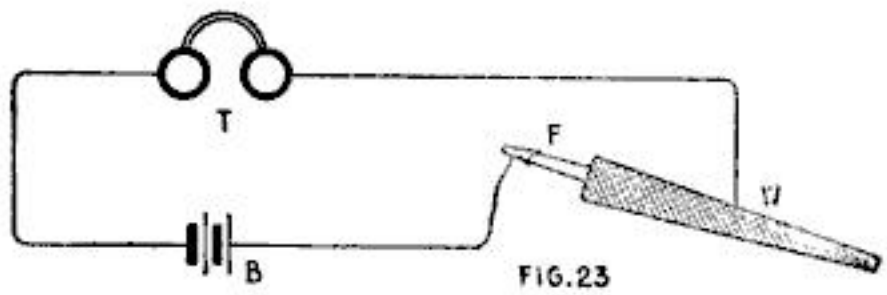
The December article described simple ways to practice reading messages when interfering sounds corresponding to undesired signals from some external radio station are heard. The four earlier instalments of this series outlined the work necessary to learn the Morse code and the sending and receiving of messages. This article takes up the study of atmospheric interference, its effects, and the reduction of harmful results from it.

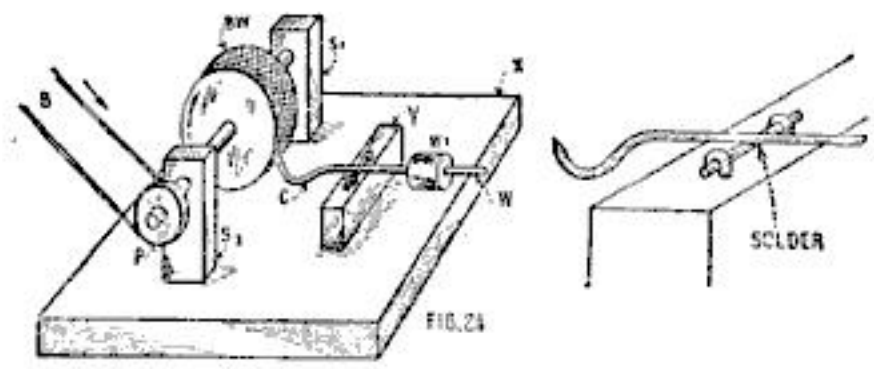
In the first place, we must examine the differences between strays and signals. These differences are, fortunately, usually well defined. First we shall consider the very practical distinction depending upon the fact that strays or static in general produce irregular noises at the receiver, while radio signals may be made to produce musical tones.

In the December article it was pointed out that practice enabled the receiving operator to distinguish between the signals heard from two stations, so that messages from one of them could be written out even though both were sending at the same time. The more skilful the receiving operator, the more closely he is able to concentrate, and the nearer alike the two signal sounds may be without producing interference. The two distinctions usually relied upon are pitch and intensity; if the signal tones are equally strong, there must usually be a considerable difference in their pitch or frequency if one is to be read "through" the other. If the interfering signal is much weaker than that from the communicating station, not so great a difference in pitch is necessary in order that the receiving operator may concentrate upon the desired dots and dashes.

Static Noises and Signal Tones

As has been indicated, since strays usually set up irregular noises rather than tones at the receiver, the operator there is usually able to concentrate upon the messages he wants to receive and to ignore the interference because of the difference in sound. Static sounds are of various





Simple method of producing a static and a more elaborate model for obtaining same results

kinds; they have been described as hissy, scratchy, or rattly, and as resembling frying or bubbling noises. They vary in character from time to time, and are often much louder than the signals it is desired to receive. Static sounds are almost never musical in character, in even the smallest degree. Since the signals from radio stations may be made either musical or non-musical (as has been known for some years), and of almost any pitch, it follows that by choosing clear musical tones the difficulties of reading messages through static noises are largely over-

come. It has also been demonstrated that the best signal-tone frequency for working through static interference is about 1000 per second, which is in the neighborhood of the second C above middle C on the musical scale. This frequency of 1000 has now been selected as standard for nearly all radio transmitters.

An Artificial Static Producer

It follows, then, that to get practice in reading signals through static we must have (in addition to the buzzers which produce the Morse signals themselves) some device which will imitate the sounds of static. The simplest way in which an idea of atmospherics can be secured is shown in Fig. 23, where a telephone receiver *T* is connected in series with a battery *B* and a coarse file *F*. The loose end of the wire from the telephone receiver, *W*, may be rubbed along the rough surface of the file. The telephone will reproduce irregular rough and scratchy noises corresponding closely to some types of strays.

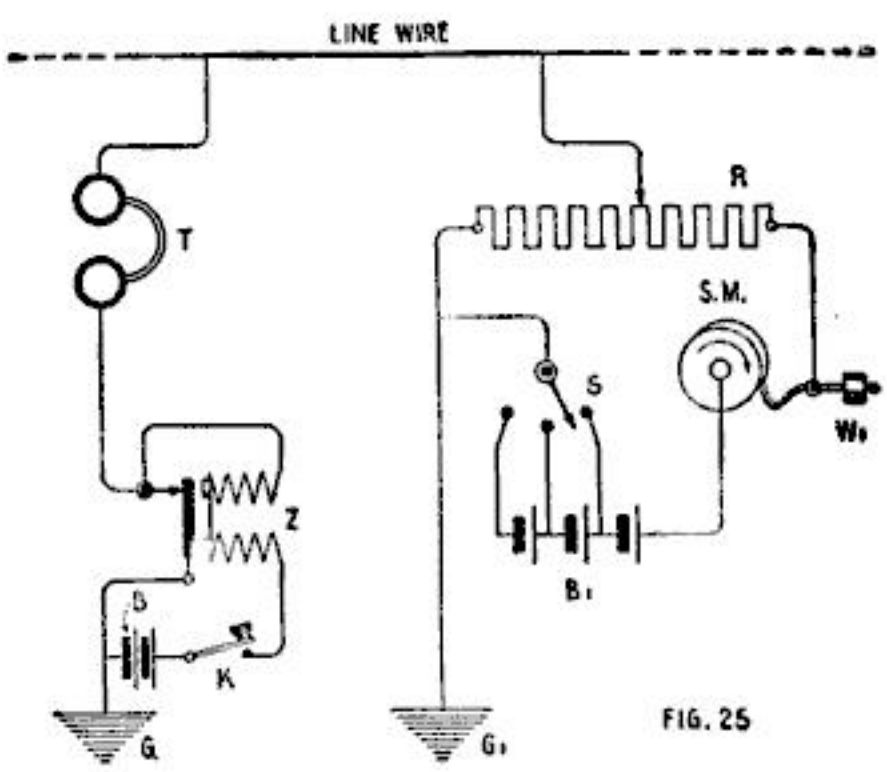


FIG. 25

One way to associate the buzzer telegraph line and the stray-maker for practice work

The file arrangement is scarcely uniform enough in action to use for regular practice, and so it will be well to make up a "static producer" or "stray maker" of the sort shown in Fig. 24. A wooden base *X* has mounted upon it a block *Y* and two drilled standards, S^1 and S^2. These standards support a shaft upon which is fastened a brass disk or wheel *BW*, about ½ in. thick and 3 in. in diameter. One end of the shaft carries a pulley *P* which permits the disk to be rotated *slowly* by belt *B*, a clockwork or back-geared motor being used as a source of power. The circumferential surface of the disk is roughened by cutting irregular diagonal V's across it with a sharp saw-file, so that its surface somewhat resembles an exceedingly coarse and rasp-like file. On the block *Y* is pivoted a soft copper wire *W*, about No. 12 in size, one end of which is bent up to rub upon the surface of the roughened disk at the contact point *C*. The other end of the wire extends out away from the disk, and a small lead weight *W'* is fastened upon it so that the pressure of contact at *C* may be varied by sliding the weight back and forth along the wire.

If the terminals of the battery and telephone in Fig. 23 are connected with the disk and the wire of Fig. 24, so that the three elements are in simple series connection, and if the disk is then slowly turned, the telephone will produce sounds like those set up by static. By varying the speed of rotation (which must always be slow—not more than about one revolution per second) and by changing the number of dry cells in the battery, almost any type of static can be imitated.

Connecting the Stray-Maker with the Telegraph Line

Now arrange the stray-maker in such a way that its imitation static can be impressed upon the buzzer telegraph line previously described. Thus, one static producer will afford practice to all the students using the line, and practice can be had in the actual exchange of messages under various conditions of atmospheric interference.

Fig. 25 shows one way of associating the buzzer telegraph line and the stray-maker *SM*. The left-hand portion of the figure represents any one of the stations along the line, and comprises the telephone *T*, the buzzer *Z*, the battery *B*, the key *K* and the ground connection which have been described in earlier articles. At any one of these stations (though preferably one near the middle of the line) the stray-maker may be installed by connecting it as shown in the right-hand part of Fig. 25. *R* is a resistance of about

This One

4PJZ-26T-EC2T

1000 ohms, with a sliding contact, such as was shown at R^2 of Fig. 18 in the December article. This is connected in series with the battery B^1 and the rotating disk *SM*. The number of cells of battery can conveniently be varied by using a three-point switch as shown at *S*. One end of the resistance unit is connected with the ground at G^1 (which may be the same connection as used for the telegraph station at *G*), and the sliding contact is connected with the line wire. The roughened wheel is slowly revolved, by use of the clockwork or motor as explained above. When the battery is turned on, the imitation static will be heard in all the telephone receivers along the line. By sliding the movable contact of the resistance toward the left or grounded end, the static sounds are made weaker. By increasing the amount of resistance between the line wire and ground connections, the noises are strengthened. It may sometimes be necessary to use more than three cells of battery, but this can only be determined for any particular buzzer telegraph line by actual trial.

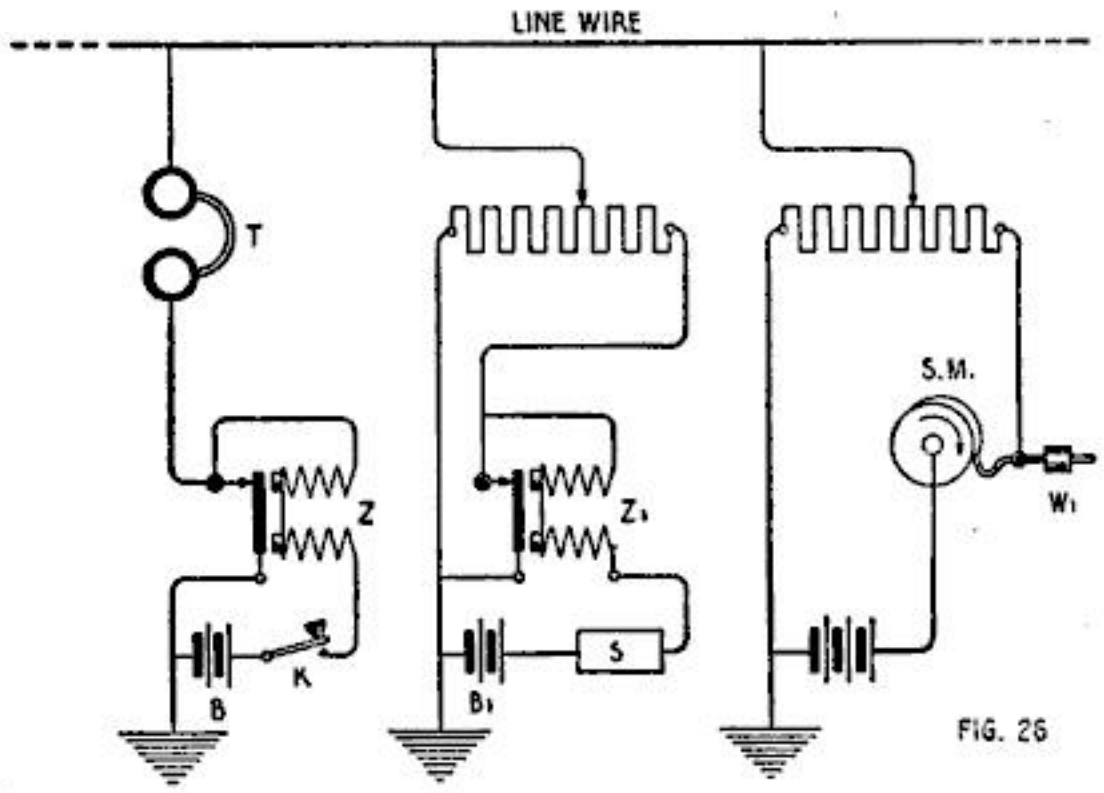


FIG. 26

Connections for reading through both station and static interferences. They are obtained by combining apparatus

Comprehensive Telegraph Practice

Having set up a buzzer line with at least two other students, and having made both the extra buzzer (with automatic sender) for imitating station interference and the stray-maker for imitating atmospherics, the student is ready to work out a course of practice-study which will fit him for the Morse telegraphing part of the most difficult operating positions. Sufficient plain code practice, without interference, should first be carried on. When there is no difficulty experienced in sending and receiving messages sent at the rate of twenty-five words (one hundred and twenty-five letters) per minute, the next necessary step to be taken is copying weak signals. By using the shunting resistance connected across the telephones, the signals are gradually reduced in intensity, and practice is continued until it becomes easy to read messages so extremely faint that the noise of a rattling window or of someone talking in the room makes it impossible to hear them clearly. This corresponds to the practical radio case of receiving messages from a great distance.

Having perfected one's self in reading weak signals, copying messages at various tone-frequencies should be tried. The article immediately preceding this in the series showed how to adjust the tone frequency of the buzzer. By following the plan given, as well as by using various types of buzzers, signal sounds ranging all the way from a low rattle to a high, piercing musical note may be produced. The expert operator is able to read messages sent with tones of any sort, and it is a good plan to practice on many different frequencies and with both loud and weak signals.

Drill in Overcoming Station Interference

The matter of station interference should next be taken up for drill. Using the automatic sender to produce interference over the entire line, one student should send cipher messages consisting of five-letter words such as QSBVH MKUIL SHDYJ WUIPO. The station sending should transmit a certain number of messages of this sort, the cipher words having been written out in advance, and all the other stations on the line should attempt to copy the signals through the

artificial interference produced by the extra buzzer and sending machine. There will thus be a race to see who can get the greatest number of words correctly, as can be determined by comparing the sent and received copies at some later time. To make things fair for all the stations along the line, the sending should be done from the station at which the interfering buzzer is located; otherwise the ratio of intensity of interfering and desired signals will be different at the different stations. Sometimes it will be found that the same mistake is apparently made by several receiving operators. When this occurs, it is nearly always safe to assume that the sending student has made an error. Thus practice of this sort is seen to be helpful in developing accurate sending as well as the ability to receive through interference.

The first station-interference practice should be made with the extra (interfering) buzzer adjusted to a pitch different from that on which the desired messages are transmitted. Likewise, for the first trials, the interfering signals should be made comparatively weak. When messages are received correctly under these conditions, the interfering signals are made stronger and stronger, until they are about as loud as or even louder than those which are being copied. After this point of skill in receiving is reached, the interfering buzzer may be adjusted until its tone approaches more closely that of the station sending messages. Work of this sort is most valuable in preparing the student to meet the actual difficulties of radio operating.

Practice in Reading Through Strays

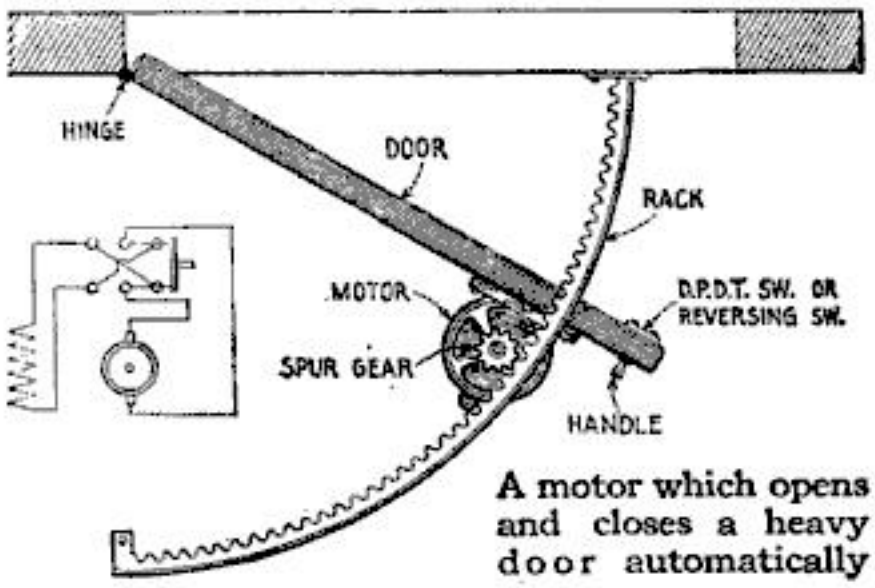
The next step is to practice in reading through static or atmospheric interference. Here the same plan is followed, except that the static-maker is substituted for the extra interfering buzzer. By sending code messages while the stray-maker is working, the strength of the interference is increased day by day until it is possible to receive messages correctly through severe disturbing noises. In this practice the desirability of using a high, clear signal-tone should be noted. Although the low tones sound much louder when no static interference is present, it is surprising to note that the higher and weaker signal tones stand out more clearly as soon as the static begins to grow strong. With practice, the student will find that he can read a high, clear musical signal through disturbing static noises many times louder than the messages. This is one of the most curious phenomena which is encountered in practical radio telegraphy, and explains the selection of 1000 per second frequency for most modern radio stations.

Practice in reading through both station and static interferences may be secured by combining Figs. 18 and 25, as shown in Fig. 26. Here the sending operator manipulates key K, while interfering signals are produced from buzzer Z' and atmospheric interference is set up by the disk SM. With the skill which can be attained by faithfully practicing in accordance with the plan outlined above, no operator need dread the difficulties of telegraphing which he may encounter in actual work. He needs in addition to this operating ability some measure of knowledge of the radio apparatus itself, and this matter will be taken up in succeeding articles.

(To be continued)

A Small Motor Used to Open Large Doors

LARGE doors like the ones used on garages are difficult to handle, and for this reason I made the attachment



A motor which opens and closes a heavy door automatically

illustrated, which may be operated with a push-button.

I attached a motor of suitable size and power at the top of the door on the inside, its shaft being supplied with a small pinion which meshes into teeth on a segment fastened to the wall or other suitable support.—H. B. PEARSON.

Wanted: Wireless War Tales

Where is the wireless operator? What is he doing?

The Popular Science Monthly wants to publish *true* stories of his deeds. They gave Owen Chick a Silver M[illegible] of a U-boat which bore the inscription "A me[illegible] of the escape of the San Melito after being [illegible] forty minutes." A. S. Mackenzie prov[illegible] wireless hero when a giant wave ripp[illegible] his ship and swept back the wirele[illegible] of deck wreckage. There wa[illegible] wireless apparatus but a m[illegible] set going and saved the s[illegible]

We want to [illegible] show ho[illegible] of [illegible]

The Metal Apron Saves a Torpedoed Ship

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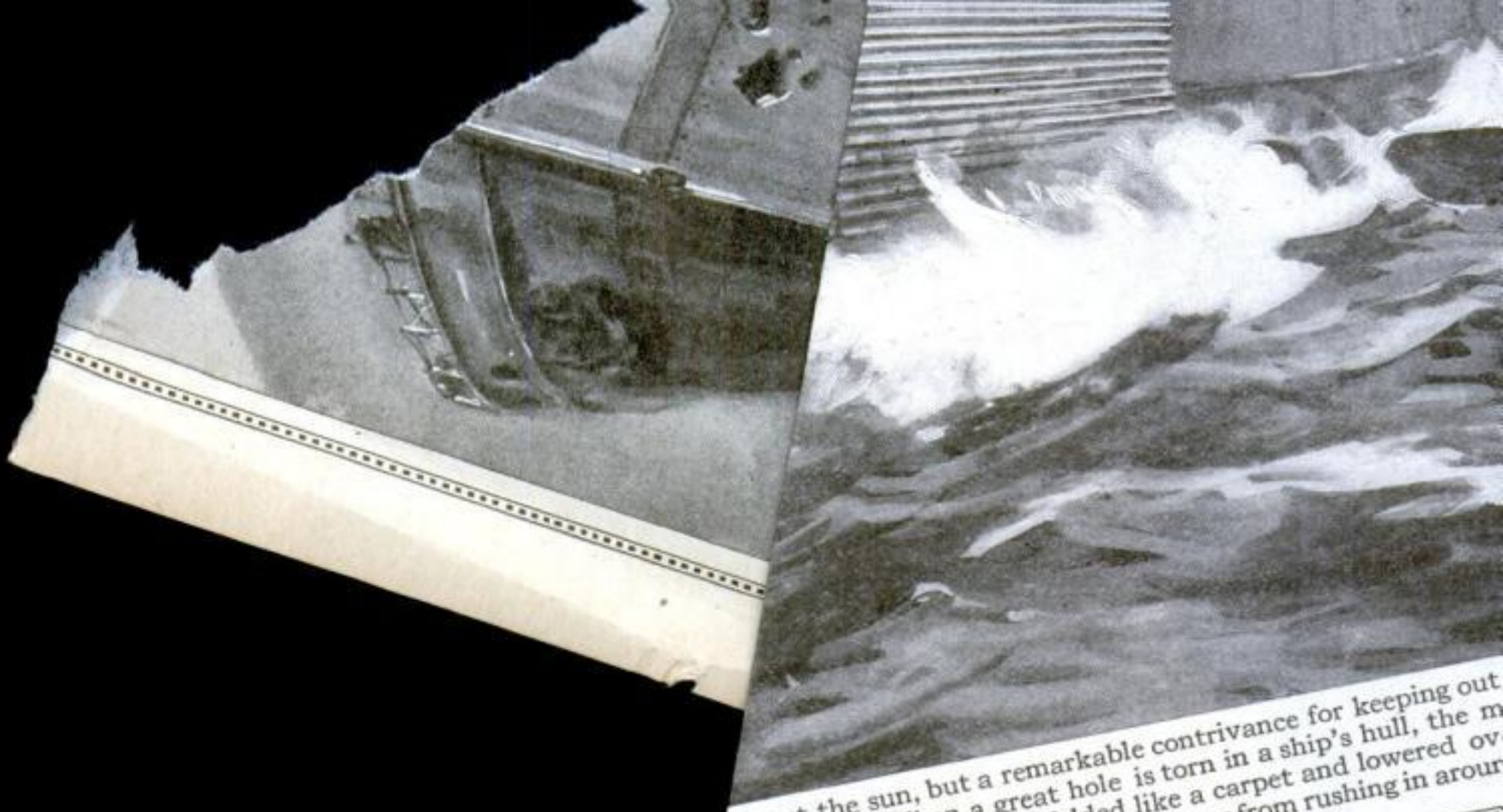

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The Popular Science Monthly wants to publish *true* stories of his deeds. They gave Owen Chick a Silver Model of a U-boat which bore the inscription "A memento of the escape of the San Melito after being shelled for forty minutes." A. S. Mackenzie proved himself a wireless hero when a giant wave ripped off a hatch of his ship and swept back the wireless cabin in a clutter of deck wreckage. There wasn't anything left of his wireless apparatus but a mass of junk. But he got his set going and saved the ship in a crisis.

We want to tell the stories of wireless heroes, to show how brave radio operators did their bit in an hour of peril—either sending out messages under a storm of shot and shell or making ingenious repairs, as brave Mackenzie did, when human life itself depended on a radio call pulsating through the ether.

We will pay for these true stories.

Send them in as quickly as you can. If you are a wireless operator yourself and it is your own account of what happened to you, so much the better. Don't be afraid to write. We want the facts. If a diagram is necessary, send it with your story. It will be welcome.

EDITOR OF THE POPULAR SCIENCE MONTHLY.

The Metal Apron Saves a Torpedoed Ship

Not a porch shade to keep out the sun, but a remarkable contrivance for keeping out the water after a vessel has been torpedoed. When a great hole is torn in a ship's hull, the metal apron carried on deck on a small wheeled carriage is unfolded like a carpet and lowered over the side. A flexible rubber or canvas pipe on the apron prevents the water from rushing in around the edges